Aviation Week

Including Space Technology

75 cents

A McGraw-Hill Publication

April 21, 1958

Structures Key To Successful Orbit Re-Entry

Douglas DC-8 Jet Transport

Jet Race Tightens With DC-8 Rollout

AVIATION CALENDAR

Apr. 28-30—Second Annual Astronautics Conference, sponsored by Air Force Office of Scientific Research and Institute of Aeronautical Sciences Shirley Savoy Hotel Denver Colo

Apr. 28-May 2—Technical Sessions of the Electrochemical Society Inc Hotel Statler New York N Y

May 4-7—Fourth National Flight Test Instrumentation Symposium, Park Sheraton Hotel New York City

May 5-7—1958 National Symposium, Professional Group on Microwave Theory and Techniques of the Institute of Radio Engineers Cubberley Auditorium Stanford University Stanford Calif

May 12-14—National Conference on Aeronautical Electronics sponsored by Institute of Radio Engineers, Biltmore Hotel Dayton Ohio

May 12-16—Airport Operators Council 11th Annual Meeting El San Juan Intercontinental Hotel, San Juan Puerto Rico

May 14-16—Spring Meeting Society for Experimental Stress Analysis Hotel Manger Cleveland Ohio

May 19-22—17th Annual National Conference, Society of Aeronautical Weight Engineers Inc, Belmont Plaza Hotel New York N Y

May 20—Conference on the Economics of Research and Development sponsored by the National Science Foundation Shoreham Hotel Washington D C

May 21-22—Flight Safety Foundation Inc Regional Business Aircraft Safety Seminar, Palmer House Chicago Ill

May 25-31—1958 Aviation Writers Assn Convention the Shamrock Hilton, Houston, Tex

June 2-4—National Telemetering Conference, Lord Baltimore Hotel Baltimore Md

June 4-5—West Coast Magnesium Sym

(Continued on page 6)

AVIATION WEEK Including Space Technology

April 21, 1958
Vol 68, No 16

Published weekly with an additional issue in December by McGraw Hill Publishing Company James H. McGraw (1860-1948) Founder Executive Editorial, Advertising and Subscription offices McGraw Hill Building 330 West 42nd Street, New York 36, N Y Publication Office 99-129 North Broadway Albany 1 N Y Donald C McGraw President Joseph A. Gerardi Executive Vice President L. Keith Goodrich Vice President and Treasurer John J Cooke Secretary Nelson Bond Executive Vice President Publications Division Ralph B Smith Vice President and Editorial Director, Joseph H Allen Vice President and Director of Advertising Sales A. R Venezian Vice President and Circulation Coordinator

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation Position and company connection must be indicated on subscription order

Single copies 75¢ Subscription rates—United States and possessions $7 one year $11 two years, $14 three years. Canada $8 one year $12 two years $16 three years. All other countries $20 one year

Subscription Address correspondence and change of address to Subscription Manager Aviation Week, 330 West 42nd Street New York 36 N Y Subscribers should give old as well as new address, including postal zone number, when changing address Enclose recent address label if possible Allow one month for change to become effective

Postmaster: Please send form 3579 to Aviation Week Including Space Technology, 330 West 42nd Street New York 36 N Y

AVIATION CALENDAR

(Continued from page 5)

posium, correlated program by the Society of Aircraft Materials and Process Engineers and the Magnesium Assn. Institute of Aeronautical Sciences Bldg., Los Angeles, Calif.

June 9-12—Semi-Annual Meeting, American Rocket Society, Inc., Hotel Statler, Los Angeles, Calif.

June 9-13—Fourth International Automation Exposition and Congress, Coliseum, N. Y., N. Y.

June 16-18—Second National Convention on Military Electronics, Sheraton Park Hotel, Washington, D. C.

June 23-July 3—Special Summer Program on Random Vibration, an introduction to the vibration problem in missiles and jet aircraft, Massachusetts Institute of Technology, Cambridge 39, Mass.

June 24-26—31st Meeting, Aviation Distributors and Manufacturers Assn., Mount Washington Hotel, Bretton Woods, N. H.

June 25-27—Air Transportation Conference, American Institute of Electrical Engineers, Hotel Statler, Buffalo, N. Y.

July 4-6—All American Aviation Exposition, County Airport, Pittsburgh, Pa. For details write: All American Aviation Exposition, Executive Headquarters, 210 Semple St., Pittsburgh 13, Pa.

July 4-6—Northeastern States Soaring Championship Contest, Elmira, N. Y.

July 8-11—The Institute of the Aeronautical Sciences, National Summer Meeting, Ambassador Hotel, Los Angeles, Calif.

July 14-15—Triennial Inspection, National Advisory Committee for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, Calif.

July 24-25—Fifth Annual Symposium on Computers and Data Processing, Albany Hotel, Denver, Colo.

Aug. 6-8—Special Technical Conference on Non-Linear Magnetics and Magnetic Amplifiers, sponsored by the American Institute of Electrical Engineers, Hotel Statler, Los Angeles, Calif.

Aug. 19-22—Western Electronic Show & Convention, Institute of Radio Engineers, Ambassador Hotel, Los Angeles, Calif.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 3-5—1958 Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 6-14—International Aviation Show, Coliseum, New York, N. Y.

Sept. 8-13—First International Congress of the Aeronautical Sciences, Palace Hotel, Madrid, Spain.

Sept. 8-13—Dynamics of Flight, University of Michigan intensive course for practicing engineers. For details: R. M. Howe, Dept. of Aeronautical Engineering, 1523 East Engineering Bldg., University of Michigan, Ann Arbor, Mich.

Sept. 22-24—1958 Meeting, Professional Group on Telemetry and Remote Control, Americana Hotel, Bal Harbor, Miami Beach, Fla.

Oct. 27—14th Annual General Meeting of the International Air Transport Assn., New Delhi, India.


HOW AMERICAN ELECTRONICS HELPS
REACH HIGHER GOALS
AMERICAN ELECTRONICS, INC.
West Washington Boulevard, Los Angeles 15, California

facts...

before you decide who will build the test equipment for your jet fleet!

Greer experience in the design and manufacture of jet test equipment started with the very first military power plants more than a decade ago Consider these achievements since that time . . .

- **Greer has built more jet test equipment than any other company in the world.**
- **Greer successfully pioneered the manufacture of the first jet test equipment.**
- **Greer has built more than 1,000 jet test machines—200 different types, totalling more than $15,000,000 in orders.**
- **Greer test equipment is owned by all major world airlines and U.S. aircraft manufacturers.**
- **Greer jet test equipment is used by every major American engine manufacturer including several leading international manufacturers.**
- **Greer has the largest plant—155,000 sq ft.—and the most complete facilities devoted exclusively to test equipment and fluid components.**

These indisputable *facts*, plus Greer's unmatched experience of over 1,500,000 engineering man-hours in jet test equipment . . . Greer's proven technical know-how . . . and Greer's expanded Airline Sales-Engineering Dept . . . add up to one sound conclusion Greer is the logical choice to contact for your jet test equipment.

For prompt and personal attention to your immediate or projected test and ground support requirements, contact Manager, Airline Sales-Engineering Dept

AT YOUR SERVICE

GREER EXPANDS AIRLINE SALES-ENGINEERING DEPT.

Airlines can now receive prompt and helpful assistance from Greer test equipment specialists This special department serves as a single source for sales-engineering and service of a complete line of matched test equipment. Greer's Airline Sales Engineering Department is now at your service, supported by the experienced Greer Service Dept

Write, Wire or Phone Greer's Airline Sales-Engineering Dept. Today!

GREER TEST EQUIPMENT

GREER HYDRAULICS INC.
New York International Airport • Jamaica 30, New York
Telephone: Olympic 9-9700
Subsidiary: Greer Hydraulics Engineering Corp. • Los Angeles, Cal

...10...9...8...7...6...5...

. . . 4 . . . 3 . . . 2 . . . 1 . . . FIRE!
When the success or failure of an entire program depends on the faultless functioning of every part—look to Ex-Cell-O parts and assemblies. They are products born of experience that has pioneered in the production of precision aircraft components for more than 35 years.

Contact Ex-Cell-O today; we'd be happy to talk over your problems in the design or production of precision parts and assemblies.

EX-CELL-O FOR PRECISION XLO

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN
Aircraft Division

MAN AND MISSILES FLY HIGHER, FASTER AND SAFER WITH PARTS AND ASSEMBLIES BY EX-CELL-O

58-18

...and now for everyone

The wraps are off RADAN! The civilian counterpart of GPL's famous military Doppler auto-navigators, is ready and available *now* — for anyone and everyone!

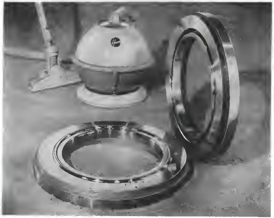
RADAN Systems have behind them millions of miles of experience in transcontinental, oceanic and polar flights ... save precious time and fuel ... provide a priceless margin of safety.

- **RADAN** — accurate: within 1% for ground speed, within ½° for drift angle
- **RADAN** — small: 4.4 cu. ft.—light: 89 lbs
- **RADAN** — operates without ground or celestial aids
- **RADAN** — virtually maintenance-free

Now in quantity production, RADAN Systems are manufactured by GPL, who developed and is the nation's leading producer of Doppler air navigation systems. Address inquiries to: General Precision Laboratory Incorporated, Pleasantville, New York.

GPL | GPE

ENGINEERS — GPL achievements have opened up some unusual research and development opportunities. Send resumé to Personnel Manager.



Graph-Mo® dies cut downtime 50% on deep draw for round vacuum cleaner!

ENGINEERS at The Hoover Company had a tough problem in getting that round vacuum cleaner shape in the new Constellation. The two circular dies that form the hemispheres often galled, picking up bits of the steel being formed. This scored the dies, marred the finished parts. Production had to be shut down while the dies were repolished. And extra polishing of the hemispheres ran up costs still more.

After studying the problem, Timken Company metallurgists recommended dies made from Graph-Mo®—a special tool steel developed by the Timken Company. Results were outstanding. The new Graph-Mo dies cut downtime 50%. The combination of free graphite particles and diamond hard carbides in its structure make it outwear other tool steels 3 to 1. Production rolled smoothly and refinishing time was cut.

Graph-Mo machines 30% easier than conventional tool steels. And its uniform response to heat treatment eliminates distortion—saves time and money in lots of tough jobs.

Graph-Mo is one of four graphitic tool steels developed by the Timken Company. If you would like more information about their uses in dies, punches, gages and machine parts, send for the new Timken Graphitic Steel Book. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN *Fine Alloy* STEEL

TRADE MARK REG U S PAT OFF

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

Out of advanced research, development and production at Hoffman

GYROS

FOR INERTIAL NAVIGATION AND GUIDANCE SYSTEMS

Electro Mechanical Equipment—such as the Air Force's ASN 6 Automatic Dead Reckoning Navigation Computer now in production at Hoffman—include gyroscopes, inertial navigation systems and components, servomechanisms, fire control systems, and guided missile controls. These are examples of the special Hoffman skills and electro-mechanical capabilities which can help solve your design problems

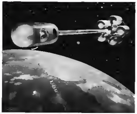
Designed and Developed by Humphrey, Inc San Diego California

Hoffman Electronics
CORPORATION

HOFFMAN LABORATORIES DIVISION / 3740 South Grand Avenue, Los Angeles 7, California
Research, Development & Production · Weapons Systems · Radar
Communications · Electronic Counter Measures · Navigation · Missile Support Equipment
Semiconductor Applications · Electro Mechanical Equipment

Significant new developments at Hoffman have created important positions for scientists and engineers of high calibre. Please address inquiries to Vice-President, Engineering.

TEST INSTRUMENTS Bulova's rugged Tachometer Tester for all jet and reciprocating systems meets MIL-T-945A requirements—is accurate to 0.1% with engines on or off. Simple to operate and maintain, this field unit also serves in maintenance depots. Precise Bulova testers include the dual purpose Torqmeter—a dynamometer or calibrated torque source



RECONNAISSANCE SYSTEMS Bulova-developed miniaturized sensor packages, geared to specific tactical missions, feed combat surveillance data to Bulova analysis and display systems. Camera, infra red, TV and radar techniques, combined and integrated, aid decision-making on land and in space. Satellite applications? Unlimited!

Bulova's capability helps to solve today's most challenging problems

To conceive, develop and manufacture a broad range of advanced electronic and electro-mechanical devices... this is the Bulova capability.

Meeting the needs of defense and industry is an unusually creative group of scientists, engineers and technicians, backed by 80 years' experience in precision production.

With dynamic imagination, Bulova's capability has invaded the often uncharted technological areas to originate many modern-day miracles in miniaturized systems and components.

Here is a proven capability ready to assist you from concept to mass production. For full information, write Department G.I.S.-2.

BULOVA
watch company

BULOVA RESEARCH AND DEVELOPMENT LABORATORIES, INC.
BULOVA PARK — JACKSON HEIGHTS — NEW YORK

INFRA-RED COMPONENTS Bulova's advanced IR projects include mosaic cells that will automatically filter out unwanted wave lengths and picture targets clearly against any background. Bulova infra red R&D covers lead selenide and lead sulfide cells, missile seeker cells, reticles, filters and thermistor bolometers... for defense and industry.

INFRA RED SYSTEMS Bulova's IR illuminators put unseen spotlights on night objectives. Bulova's development capability extends to fire control systems that detect, track and automatically lock on target. Designed for accuracy and simplicity, these high resolution units will serve our nation's land, sea and air forces.

Is your airline giving the business traveler what he really wants?

What Business Travelers Want	What Lockheed Electra Delivers
1 Want to save time	**Fast Flights**—Electra/Flight gives your passengers quick taxi and maneuver, swift take-off, fast climb... swifter in the air—saves time on the ground, too.
2 Want flights to leave "when I want to go"	**More Flights Per Day**—Because the Electra costs less to run, and gets around faster, it provides more flights to choose from . . .even to smaller cities. **Close-To-Home Service**—Electra can take a full payload in and out of *today's* close-in airports—which handle 90% of *all* traffic. This short-runway ability is proved in flight tests where Electra landings and take-offs are being made in less than 1,900 feet—without prop reverse or wheel brakes!
3 Hate delays ...in starting off ...in refuelling at stops on the way ...in getting their luggage	**Less Time Waiting On The Ground**—Passengers, baggage, food and fuel all load at the same time. Electra/Flights leave right from terminal, carry ample fuel for many stops. Passengers can carry hand baggage on and off plane . . no annoying waits.
4 Hate "Weather Ahead" delays	**All-Weather Scheduling**—To avoid weather delays, Electra can take-off and fly at any altitude from 5,000 to 20,000 feet with less than 1% variation in speed on a typical 400-mile flight.
5 Want safety, security	**Four Dependable General Motors Allison Prop-jets**—Passengers like the feeling of security when the big props quickly "take hold" on a wave-off . . . or bring the Electra to a safe stop on a slick runway.
6 Want to relax in comfort, to arrive fresh and ready for business	**Vibration-Free Flight**—Quiet, no quiver—no shake. Passengers will remember this about Electra/Flight. **"Living Room" Comfort**—Electra's wide fuselage allows new wider 20" seats . . . wider "room-to-pass" aisles. Large "picture windows" give a broad view. Radiant heated, fully pressurized air-conditioned cabin adds to passenger comfort. Interiors designed by Henry Dreyfuss.

Electra/Flight gives the business traveler exactly what he wants

PURCHASED BY: *Aeronaves de Mexico · American Airlines · Ansett/Ana of Australia · Braniff Airways · Cathay-Pacific Airways · Eastern Air Lines · Garuda Indonesian Airways · KLM—Royal Dutch Airlines · National Airlines · PSA—Pacific Southwest Airlines · Western Airlines*

LOCKHEED AIRCRAFT CORPORATION · BURBANK, CALIFORNIA

Lockheed Electra

The finest short-to-medium haul turbine-age airliner...designed to assure you of maximum return on every operating dollar.

April 21, 1958

Aviation Week
Including Space Technology

Vol. 68, No. 16
Member ABP and ABC

EDITORIAL OFFICES New York 36—330 W. 42nd St., Phone LOngacre 4-3000 (Nights LO 4-3035) Washington 4, D. C.—National Press Bldg., Phones NAtional 8-3414 REpublic 7-6630 Los Angeles 17—1125 West Sixth St., Phone MAdison 6-9351 Dallas 1—1712 Commerce St., Phone Riverside 7-5117 European Office—1 rue du Temple, Geneva, Switzerland Phone 32-35-63

PUBLISHER Robert W. Martin, Jr.
EDITOR Robert B. Hotz

MANAGING EDITOR William Gregory
EUROPEAN EDITOR David A. Anderton
WASHINGTON Cecil Brownlow
NEW YORK Robert I. Stanfield, Harry Raven, Herbert J. Coleman
LOS ANGELES Irving Stone, Richard Sweeney, Russell Hawkes
DALLAS Craig Lewis
ENGINEERING J. S. Butz, Jr., Michael Yaffee
AVIONICS Philip J. Klass, James A. Fusca
CONGRESS Katherine Johnsen, Ford Eastman
SPACE TECHNOLOGY Evert Clark
TRANSPORT Glenn Garrison, L. L. Doty, Robert H. Cook
EQUIPMENT Barry Tully
BUSINESS FLYING Erwin J. Bulban
ART EDITOR Lawrence J. Herb
ASST. ART EDITOR Robert G. Young
SPECIAL PROJECTS Jerome E. Kelley
EDITORIAL PRODUCTION Arnold Sherman
ASSISTANT EDITORS Elizabeth M. Hein, Edith Walford
EDITORIAL ASSISTANTS Marjorie Nail, Jerome Bailey, Marjorie Todd
LIBRARIAN Eleanor D. Prata

FOREIGN NEWS SERVICE

EDITOR John Wilhelm
LONDON John Tunstall
PARIS Robert E. Farrell
BONN Morrie Helitzer
MEXICO CITY Peter Weaver
TOKYO Sol Sanders

DOMESTIC NEWS BUREAUS

ATLANTA 3 1301 Rhodes-Haverty Bldg.
CHICAGO 11 520 No. Michigan Ave.
CLEVELAND 15 1510 Hanna Bldg.
DETROIT 26 856 Penobscot Bldg.
HOUSTON 25 1303 Prudential Bldg.

SALES

ADVERTISING SALES MANAGER E. P. Blanchard, Jr.
ATLANTA R. H. Powell
BOSTON A. C. Boughton
CHICAGO and ST. LOUIS J. S. Costello, F. E. Hinman
CLEVELAND H. P. Johnson
DALLAS Gordon Jones, E. E. Schirmer
DENVER John G. Patten
DETROIT R. R. Butera
LOS ANGELES C. F. McReynolds, D. T. Brennan, C. A. Ransdell
NEW YORK M. J. Storz, R. G. Hathaway, J. M. Grinlan
PHILADELPHIA J. R. Willis, W. L. Blanchard
SAN FRANCISCO William Woolston
PROMOTION AND RESEARCH MANAGER W. H. Jack
C. C. Gersna Asst.

RESEARCH AND MARKETING

Mary Whitney Fenton, Judith P. Wheeler, Lenel Sullivan

BUSINESS

BUSINESS MANAGER J. G. Johnson
CIRCULATION MANAGER T. J. Lucey
PRODUCTION MANAGER W. V. Cockren

COVER Target date for first flight of the Douglas DC-8 turbojet transport, shown at recent rollout (AW April 14, p. 40) is May 15. A total of 138 DC-8s has been ordered by airlines. First certificated aircraft is scheduled for delivery in October, 1959. First of a two-part series on the economics, performance and design of the DC-8 begins on page 102.

PICTURE CREDITS
27—Aviation Week; 34—Vertol; 37—Fairchild; 40—De Havilland; 43—Sovfoto; 55—NACA; 59—Perkin-Elmer; 61—Ryan; 102, 103, 109—Douglas; 119—Northrop; 127—North American; 131—Collins Radio; 135—Aeroquip; 136—Aeroquip, Linde; 139—RCA, USAF; 144—Avco; 147—Hiller

73,367 copies of this issue printed

Financial Storm Brewing

Last summer and fall the aviation industry and its related technologies were put through a financial wringer by government fiscal policies that are still being felt in virtually every phase of the currently receding economy. It does not take a doctorate in economics to trace the beginnings of the present economic slump to the traumatic shock induced in the nation's largest manufacturing industry by the government's fiscal bungling of last summer when Pentagon officials blandly announced they would not pay any bills then legitimately due for at least another six months.

Bosic Problem

In addition to the visible economic damage inflicted on the aviation industry, these fiscal policies threw a cold shock of fear down through all of the economic channels of subcontracting and supplies that carry the defense dollar down to the grass roots of the American economy.

Basically, the defense fiscal problem has been the result of a consistent failure of the executive planners to face up to the full cost of the defense program they have repeatedly promised to provide for the American people. After the end of the Korean war in 1953 there were large sums of appropriated but unexpended funds available to all three services. For several years the services were able to finance their programs adequately out of the Korean surplus despite radically reduced new appropriations. When the Korean surplus was exhausted, the civilian leaders of the Defense Department refused to face the hard financial facts of their problem. They continued the below par budget requests while continuing to trumpet that they would provide an adequate defense program. Each year since Fiscal 1955, the gap between the program promised and the money budgeted to finance it has widened.

Industry Forced to Borrow

This was first glossed over by cutbacks in defense strength labeled as "efficient economy." Last year the crisis became so acute that in the Air Force alone, according to a memo from Secretary James Douglas to the then Defense Secretary Charles E. Wilson, a $4 billion gap existed between authorized hardware procurement programs and the funds available to pay for deliveries of this hardware. To solve this problem, the Pentagon civilian leadership told the industry to go out and borrow the money they needed to tide them over until the government could pay its bills. This advice came despite the fact that interest paid on these borrowed funds was denied by the same officials as a legitimate cost of doing business.

When Neil McElroy became Secretary of Defense last fall, he made a valiant effort to straighten out this fiscal mess he had inherited from his predecessor. However, the problem was more acute than was generally realized, and Mr. McElroy's measures, instituted in an honest effort to solve the problem, are now about to be inundated by a new flood of underfinancing. Details of how this new financial crisis is hitting the Pentagon are reported on page 26 by Cecil Brownlow, Aviation Week's Washington bureau chief. Navy admirals also have testified before Congress on the details of how their aircraft and missile procurement programs are being squeezed in this continuing financial bind. Again the aviation industry is being asked by the government to wait for payment on work completed under legitimate contracts with the military services. "Deferred billing" is the polite Pentagonese for this brutal financial practice.

Everybody from President Eisenhower on down agrees that our defense effort must be strengthened and accelerated to successfully repel the Soviet challenge in the space age. But how can such a goal possibly be achieved by pursuing fiscal policies that are viciously whittling the basic strength from our new weapons development programs?

Full Discussion Needed

We believe that this is a question that should be thoroughly explored by the Congress and the American taxpayer. It is a problem that so far has been pretty well kept within the confines of the Pentagon and the executive branch of the government. We sense a reluctance on the part of the aviation industry, which is being most brutally squeezed by these fiscal policies, to discuss them publicly. This is a grave mistake. Leaders of the aviation industry owe it to the American people to explain these fiscal facts of life in detail. Only by a full and open discussion of these problems will any sort of intelligent and permanent solution be attainable.

The present Pentagon policy of simply sweeping its fiscal dirt under the rug of the next fiscal year is increasing the magnitude of the fiscal gap with each passing year. At the same time, it is eroding the military strength of our national defense program. It cannot be permitted to continue any longer without permanent and perhaps irreparable damage to the entire military posture of this country and its allies.

Whatever the hard fiscal facts of the Defense Department problem may be they must be faced squarely and solved effectively. Otherwise, we will pour the billions already appropriated into a vitiated effort that will fall significantly short of producing the defense strength required to maintain our position as a successful leader of the free world.

—Robert Hotz

WHO'S WHERE

In the Front Office

Edward W. Ringo, executive vice president, Transocean Air Lines, and board chairman of Flight Enterprises, Inc., subsidiary of Transocean Hartford Conn **Donald Zipfel** succeeds Mr Ringo as president of Flight Enterprises Also **George McCusick** vice president of Flight

Louis M Purcell, president, Dressen-Barnes Corp, Pasadena, Calif Also **Ross C. Sargent** vice president operations, and **Walter S Baumgartner,** vice president-sales and engineering

Henri Busignies, president, newly consolidated IT&T Laboratories, International Telephone and Telegraph Corp., New York.

William T. Snebold, vice president and general manager Hycon Mfg Company, Pasadena Calif

Earle K. Brownridge, executive vice president and general manager, Orenda Engines Limited Toronto, Canada

Norman P Blake, vice president, and **Howard M. Blackwell,** assistant vice president-services of supply, Pan American World Airways, Inc **John T. Shannon** succeeds Mr. Blake as Atlantic Division manager

Harry E Gude, vice president manufacturing, Aluminum division, Olin Mathieson Chemical Corp, New York, N Y.

Fred K. Powell, Jr., head of Defense Products Program, American Machine & Foundry Co, New York, N Y Gen. **Laurence C. Craigie** (USAF, ret.), Deputy of Defense Products in charge of the Ballistics Missiles Program Mr Powell is vice president-engineering, Gen. Craigie is also a vice president

Charles S. South, vice president and assistant to the president, Braniff International Airways, and **Thomas P. Robertson,** assistant vice president research and statistics

Honors and Elections

Edward S. Carter, Jr, assistant chief of the avionics section of the Sikorsky engineering department's dynamics branch, has received the first George Mead Gold Medal for outstanding engineering achievement in United Aircraft Corp, three of Mr Carter's associates, **Harold S Oakes, Jr, Jack T. Stultz,** and **Henry R. Angel,** have received George Mead silver medals

John Wild, director of engineering for ARO Inc., has been named to Research and Engineering Advisory Panel on Aeronautics, Department of Defense, Washington

James Martin, chief designer and managing director of Martin-Baker Aircraft Company of England and Canada, has received the Laura Taber Barbour Award The award, which is administered by Flight Safety Foundation, is given annually for achievement in aviation safety

Lt. Henry B. Grudberg, Project Engineer, Helicopter Section, Aeronautical Research Branch, Transportation Research and Engineering Command, has won the Institute of the Aeronautical Sciences' Flight Test Engineering Fellowship

(Continued on page 159)

INDUSTRY OBSERVER

► Polaris fleet ballistic missile subsystems have been tested in 12 flights thus far from USAF Missile Test Center, Cape Canaveral, Fla Missile system as a whole is scheduled to begin flight tests sometime this fall Four-barreled Aerojet solid propellant powerplant is now being static tested on a once-every-48 hr basis

► Navy would like an additional $11 million in Fiscal 1959 to help speed development of its Subroc underwater-to-air-to-underwater anti-submarine missile, Program has now reached the negotiation stage with industry. Subroc is scheduled to have a range of between 25 mi and 50 mi; be capable of carrying an atomic warhead Detection technique is expected to cause more problems than either launch or guidance methods.

► Airways Modernization Board may take over sponsorship of Bendix Radio's air collision avoidance system investigation following an Air Force decision to divert funds originally scheduled for the project to space oriented programs.

► Exploitation of microminiature construction techniques developed by Army's Diamond Ordnance Fuze Laboratory which shows promise of reducing size and weight of avionic equipment to from 1/10th to 1/100th that of present units is being slowed by lack of funds Technique, including new process for making microminiature transistors which appears ideal for space vehicle use, reportedly could be greatly accelerated with an additional $100,000 in funding

► Adoption of shock-absorbing suspension system for screening out vibration to protect guidance and other equipment is being considered for use with the Thor intermediate range ballistic missile's Rocketdyne rocket motor Motor is now solid mounted with ball and socket joints.

► Navy-Temco Corvus air-to-ground tactical missile will home on enemy radar stations in final flight to target.

► Soviet Navy has been conducting negotiations with Egypt and Yemen for permission to base 900-mi range, IRBM-carrying submarines at Port Said and Salif on the Red Sea Permission would give the Soviets bases at each end of the Suez Canal.

► Wright Air Development Center has requested bids for airborne signal reconnaissance systems Cost of contract will be approximately $40 million. Purpose is to intercept, record and analyze enemy signals over a broad frequency spectrum at much greater than normal transmission distances.

► New Grumman Ag Cat agricultural biplane (AW Nov 25, p 32) will be produced by Schweizer Aircraft Corp, Elmira, N Y under agreement signed by both firms Schweizer is currently building production tooling for Ag Cat to provide for output of some 100 aircraft Price tag will be approximately $17,500 and Grumman feels that "there won't be any problem" in selling airplanes Grumman has appointed four independent distributors in U S to sell its new biplane Magnolia Aviation, Laurel, Miss, Sun Valley Dusting Co., San Benito, Tex United Heathorne Co, Richmond, Calif, and Mid-Continent Aerial Sprayers & Dusters, Inc, Hayti, Mo.

► Quick unloading in combat conditions with no ground equipment is the design aim of one modification of the Nord-Aviation 2501 Noratlas transport Aircraft has been built with modified landing gear that can partially retract on the ground with the full weight of the plane on it Partial retraction tips the floor level down and aft so that wheeled loads can roll out the back door. Inertia unloading also can be done if the pilot stops the aircraft, retracts the wheels partially and then guns the engines. The plane pulls away rapidly, and the load slides out the rear door.

► Bell XV-3 fixed-wing VTOL has tilted its wing-tip rotors forward 60 degrees from the vertical during flight tests. Complete conversion is expected soon.

Washington Roundup

Reorganization Lines Drawn

Despite Defense Secretary Neil H McElroy's clear warning to military leaders that they are expected to support the President's defense reorganization plan and express opposing ideas only if questioned by Congress real attitudes of the services toward the plan are reflected in statements by their associations Navy League has expressed strong opposition to most of the plan's features

After a study by its Airpower Policy Committee, Air Force Assn last week pledged full support in principle "insofar as the plan represents a considerable advance in the direction of true unification called for in AFA policy," but expressed everything from general approval to "grave fears" about specific points Army also is believed to be willing to go along with most of the points in the program.

AFA's greatest concern was expressed over increased management authority for the Secretary of Defense AFA said it favors "concentration of policy-making authority, but we consider it equally essential to decentralize fully day to day operations and detailed administration. The present extreme manifestation of Parkinson's Law in OSD is both unsound and unhealthy."

Proposal to centralize research and development gave AFA "certain grave reservations" The association said Defense Department's role in this area "has been essentially repressive, rather than creative," and said the "tendency has been toward indecision and nitpicking over ways and means, rather than broad policy making and direction"

USAF Chief of Staff Gen Thomas D White said one day later that he had studied the President's plan and "as I understand his proposals, I understand their implementation will be of great benefit to the security of the country The Air Force is wholeheartedly in accord with the President's reorganizational proposals"

Sputnik II's Return

Russia's Sputnik II earth satellite returned to earth in pieces last week with the major portion falling in the Atlantic Ocean near Barbados B W I A Naval Research Laboratory spokesman said that the rocket casing was seen over Denver about an hour later and its impact point was unknown

U S estimates of the size and weight of Sputnik II which have been made from tracking data indicate that the satellite weighs between 6 000 and 8 000 lb and is probably about 70 ft long, the approximate length of the complete Vanguard rocket These estimates made by U S agencies connected with the IGY program agree with one made by Dr John P Hagen, Vanguard project chief that the longitudinal cross-sectional area of the orbiting body is about 300 sq ft From the standpoint of aerodynamic drag calculation, the equivalent cross-sectional area of Sputnik II as it tumbles randomly is estimated at 180 sq ft

No-Show Opposition

Airlines' no-show penalty plan which, statistically, has been hailed a success by the Air Transport Assn since its adoption last year, is now running into strong unexpected opposition from at least three airlines At a recent meeting of the Air Traffic Conference, American Airlines, an early proponent of the plan, cast its vote against a move to extend the plan until April 1 1959

American was joined in its dissenting vote by Allegheny Airlines and Mohawk Airlines, the latter claiming that "it is our responsibility, not the passenger's to fill our seats" A compromise move to extend the penalty ruling until Sept 1 and to meet again on May 13 for further discussions on the plan was accepted unanimously by all members of the Air Traffic Conference Air Transport Assn statistics on the plan derived from periodic surveys of the operation of the ruling have consistently indicated the plan was meeting very little passenger resistance and had materially contributed to a decline in the number of no-shows

Army Purchase Plans

Army plans procurement of 429 aircraft during Fiscal 1959 These are 24 medium cargo helicopters with a three-ton payload 60 quarter-ton payload utility helicopters 176 two-passenger reconnaissance helicopters 31 two-passenger fixed wing observation aircraft 100 fixed wing utility aircraft 29 fixed-wing cargo aircraft with a 1.5 ton payload capability nine research and development aircraft

Sen Norris Cotton (R-N H) has criticized the administration for failing to ask Congress to authorize construction of more Polaris missile submarines in the Fiscal 1959 defense appropriation requests Cotton said he had hoped the President would ask for at least six more Polaris submarines rather than the two actually requested in order to provide what he termed the most defense and greatest security at the least cost

Concentration on missile submarines where the U S already has a clear lead in production and experience he said, can enable the nation to leap-frog Russian developments in missiles and retain the balance of world power on the side of the free world and peace

Progress vs. Secrecy

House Government Information Subcommittee reporting on hearings on secrecy and scientific information begun two years ago urged abolition of the "need to know" criterion adoption of a uniform security clearance for all agencies and all defense contractors, and an end to attempts to "hide discoveries of the basic laws of nature made in the past, present or future"

Subcommittee headed by Rep John E Moss (D-Calif) concluded that "the only real national security lies in scientific progress" and said this progress "has been severely hampered by excessive secrecy regulations administered by the Department of Defense" Report called the multiple clearance system "inefficient uneconomical" and said "need to know" erects "another barrier" between the scientists and information he needs

CAA Transfers

Civil Aeronautics Administration last week named Hebert H Howell, director of its Office of Airports for the last five years, to serve as assistant to the administrator for the development of the Washington National Airport The new airport will be located at Chantilly Va, and is scheduled to be ready to handle jet transports by early 1961 George R Borsari, 16-year veteran of the CAA Office of Airports, will succeed Howell as Director of the Office of Airports —Washington staff

New Financial Crisis Looms for Industry

Treasury Department cash stringency forces USAF, Navy to slow payments, slip schedules for delivery.

By Cecil Brownlow

Washington—Aircraft industry may soon be faced with a financial crisis approaching that of last fall when government fiscal policies forced rigid expenditure ceilings on a contract-by-contract basis.

After a brief post-Sputnik relaxation on expenditures by the Budget Bureau, Air Force and Navy's Bureau of Aeronautics are again being forced to stretch progress payments, order slippages in delivery schedules and request deferred billings. The reason—stringent Defense Department expenditure targets dictated by a lack of cash on hand at the Treasury Department.

One spokesman said last week that, so far as industry is concerned, "the storm isn't here yet, but the shingles are beginning to blow off the roof."

USAF, Navy Cuts

Main effort by Air Force and Bureau of Aeronautics at present is toward deferring Fiscal 1958 debts until Fiscal 1959.

Under present programs, Air Force and BuAer could be almost $1 billion short of having the money on hand to meet their Fiscal 1958 bills by the end of the fiscal year on June 30.

Navy already has made sharp cuts in its planned aircraft program (AW April 14, p. 26) and has made verbal requests to segments of industry to delay billings for hardware deliveries until after the end of the fiscal year.

Air Force has ordered new slippages in delivery schedules and, in some cases, has delayed the final signing of letter contracts in order to hold down spending until the beginning of Fiscal 1959.

Payment Delay Rises

Delay in the payment of bills on the part of the Air Force has not yet reached the peak of last October, but it is increasing—from a normal interval of 38 days to approximately 50 by Dec. 31. The delays in collection have increased still more in the last six weeks.

Under Department of Defense Instruction 7800.6 issued last November, both services have cut progress payments on cost plus fixed fee contracts from 100% to 80%. Industry must finance the remaining 20%, generally through bank loans, until delivery of the final product.

If the ruling remains in force, and there are no signs that it will be rescinded, an industry spokesman said last week that aircraft firms will have to abandon the course now normally followed of financing through bank loans.

There is no overall estimate as to just how much industry has had to borrow since the ruling went into effect or how much it may have to borrow during the coming year. However, when Air Force was following a policy of partial funding last year, it was estimated that industry might be called on to borrow as much as $1 billion and, the spokesman said, "there just isn't that much money in the banks."

The alternative industry may be forced to face is to go on the market with long-term bonds such as the $60 million issue recently offered by Douglas Aircraft Co. Smaller companies might be less capable of attracting investors. They also might balk at the risk involved since the heavy carrying charges could prove to be ruinous if military payments failed to come through on time.

Change in Terms

The term, expenditure target, has replaced that of "expenditure ceiling" used by Defense Department during the scarce money days of last summer and fall and, to a degree, imposes less hardship on industry. The ceilings were absolute and on a contract-by-contract basis.

The targets are subject to at least some appeal by the service secretaries to Defense and by industry to the individual services.

Rather than asking industry to take over a large portion of the financing of a particular contract as they did under the expenditure ceilings, the services are asking for deferred billings.

"That way, a spokesman for industry said, "they can still say they are paying all proper bills submitted as (Defense Secretary) McElroy promised they would do" (AW Nov. 4, p. 26).

One area particularly hard hit is Series 200 contracts for procurement other than aircraft. Air Force is having difficulty, for example, in finding funds to finance ground support equipment for the Convair F-106 and new models of the McDonnell F-101 series now coming off the line.

"We have several contracts in this line we want to let right now, but we just don't have any money to do it," an Air Force spokesman said.

The appearance of Fiscal 1959 will offer no final solution and probably no more than slight temporary relief.

Congressional appropriations for defense, spurred by the reaction to Russia's technological gains, are generally sufficient to support the major defense programs.

The problem, and the reason behind the stringent Defense Department expenditure targets, is a lack of available funds in the Treasury Department.

The recession in the nation's economy has cut back on anticipated tax receipts, particularly from large manufacturers such as those of automobiles. This industry is experiencing one of its worst years.

Coupled with this is the fact that costs of federal programs are going up on an across-the-board basis.

As examples—other than the increasing cost of defense—outlays to support the social security program are now greater than the benefit payments taken in; gasoline taxes, formerly used to support a variety of projects, are being absorbed by the federal highway program.

Unemployment benefits also are cutting into the money on hand.

Debt Ceiling Increase

The recently authorized $5 billion increase in the debt ceiling has failed to materially help the Defense Department expenditure problem. As one industry spokesman explained, "unless Department of Defense gets the courage to go back to the President and say the expenditure targets will have to be lifted, Fiscal 1959 could be as bad as Fiscal 1958."

"We're going to have," a service official said, "our normal 1959 expenditures plus everything swept into it from Fiscal 1958 and it's going to be a critical problem."

Any substantial increase in the expenditure targets would require another boost in the debt ceiling. If the President agreed to ask for such a politically unpopular move, it still could come under heavy fire from an election-year minded Congress.

Employment Decline Slows

Washington—More than 140,000 jobs have been abolished in a full year of declining employment in the aircraft industry, but some observers believe the decline may level off by the end of next month.

Even with the sharp increase in defense contracting as compared with the last half of 1957, the industry probably would take a full year or more to regain its April, 1957, peak employment of 909,100 because of the long lag between initial contracting and volume production. Continuing trend toward fewer weapon systems and fewer units of each system could mean that the 1957 peak will not be reached again, although the volume of work now ordered or planned by Defense Department is certain to bring a considerable increase over the present number of jobs.

Downward trend that began last May probably will stabilize at approximately 750,000 jobs. At the beginning of last year employment was still climbing. The increase from January to February of 1957 was 13,300, according to Bureau of Labor Statistics figures. Then the increase slowed considerably to 3,800 between February and March, and to only 500 workers between March and April.

From the April peak, the curve dropped slowly each month through July. As the new fiscal year began, with its tight expenditure policies, the job decline accelerated to 17,000 laid off between July and August, stayed almost at that level—17,300—between August and September, and jumped again to 21,300 between September and October.

Between October and November, employment dropped by 41,000, taking its sharpest dip of the year. Since then, the decrease has been slowing steadily. November-to-December drop was 19,000 jobs, December-to-January was 13,000.

February figures, not yet released, are expected to show a decline of little more than 8,000 from the previous month. An even smaller decline is expected in April, and May could see leveling off of the curve. Employment may begin its upward trend by the end of June or early July.

Nike-Zeus to Resemble Nike-Hercules

Artist's conception of Nike Zeus missile shows how it will resemble scaled-up version of Nike Hercules. Increased size of solid fuel engine would eliminate need for booster when missile is used against aircraft. Artist has depicted an anti-missile missile version with booster added. Drawing shows weapon immediately after burnout and separation of booster.

Navy Annual Budget Short by $6 Billion

Washington—Navy requires a $17 billion-a-year budget for the next 10 years—about $6 billion-a-year more than its budgets over the past few years, Vice Adm. Thomas S. Combs, Deputy Chief of Naval Operations, reported to the House Armed Services Committee. He said:

- **Aircraft procurement should be increased** from $2 billion a year to $3.5 billion.
- **Ship construction, emphasizing** Polaris-equipped submarines and nuclear powered carriers, should be raised from $1.5 billion to $2.2 billion a year.

Adm. Combs pointed out that Navy's number of operating aircraft "is declining steadily" (AW Apr. 14, p. 26) and said that its anti-submarine warfare capability "is marginal at best."

"Unprecedented increases in aircraft costs and a combination of financial limitations are forcing us to adjust to lower operating levels," he said. "We are modifying our force structure to retain maximum combat capability as we reduce, but a continuation of this trend will create unacceptable deficiencies in quality or quantity, or both.

"In support of these lower operating levels, we must obtain high performance aircraft that can deal effectively with the advanced planes with which Russia has equipped both herself and her satellites.

"To do so, additional funds must be devoted to aircraft procurement in coming years."

In anti-submarine warfare, he said: "We face the added threat of Soviet submarine advances which lie in the immediate future.

"We face this increasing threat with a level of strength that provides only a marginal defense. . . . The capabilities of our anti-sub forces must, as a matter of urgency, be increased."

Service Officials Back NASA Space Plan

By Ford Eastman

Washington—Leading Air Force, Army and Defense Department technologists strongly endorsed legislation last week that would transform an expanded National Advisory Committee for Aeronautics into a national space agency

Supporting the proposal at hearings of the recently-formed House Committee on Astronautics and Space Exploration, were Lt Gen Donald L Putt, USAF deputy chief of staff for development, Herbert York, chief scientist of the Advanced Research Projects Agency, and Wernher von Braun, Army Ballistic Missile Agency director of technical development USAF support Strongest endorsement was given by Gen. Putt who told the committee that Air Force fully supports the proposal He said.

"NACA has much to offer as a national space agency outside the Defense Department The basic charter states it is to supervise and direct the scientific study of the problems of flight with a view toward their practical solution And in discussing space technology it should be recognized there is no division, per se, between air and space For all practical purposes, air and space merge, forming a continuous and indivisible field of operations Thus, NACA already has great responsibility in the astronautics sciences"

Any ventures into outer space, Gen. Putt told the committee, should be based on the foundation of knowledge already accumulated in flight within the reasonable atmosphere

Gen Putt pointed out that NACA research and development helped the U.S to become the undisputed world leader in air transport and is credited with substantial contributions to the efficiency of current supersonic military aircraft He added that many of the research facilities needed as basic tools for exploration of outer space are already at hand in the NACA

"Perhaps the most important," he added, "NACA has established a fine working relationship with the military services scientific fraternity and industry Its leaders are as respected as the scientific data that result from its research activities"

Two military space vehicle projects which also would have beneficial peaceful uses Gen Putt said are

- "A reconnaissance satellite for surveying and mapping the surface of the earth Eyes in outer space will keep us informed of military movements on the earth's surface Mapping accuracy will be increased greatly military targets throughout the world could be plotted for greater accuracy We would have almost immediate warning of hostile action anywhere on the surface of the earth, which in turn would permit faster reaction on our part

On the other hand, the reconnaissance satellite should prove a boon to weathermen everywhere Thousands of lives and many dollars could be saved by precision forecasts of hurricanes typhoons and other severe weather"

- "The second vehicle . . . is the communications satellite . . . Several suitably equipped and located satellites could serve as radio and television relay stations able to receive signals from any point on the earth and relay them either directly or via another satellite to any other point Solar or nuclear energy power sources could give them useful lives of many years."

Gen Putt also publicly mentioned Air Force plans which have not been approved to shoot a manned recoverable capsule-satellite into orbit around the earth by next year, (AW April 7, p 26) and preparations for lunar probes of the moon later this year

Both von Braun and York said they were in general agreement with the proposed legislation to form the National Aeronautics and Space Agency with NACA as its nucleus but expressed reservations in respect to some provisions

The present NACA charter, they said, is not designed to handle the present space program The agency, they added, should have more authority and sufficient funds to get the job done and not be forced to operate in an advisory capacity They also objected to any language that would limit research to projects that have well-defined requirements.

Both von Braun and York said that such language would eliminate research on projects such as the million lb thrust rocket engine, for which there is no immediate requirement but for which there will be in the near future.

Von Braun said that if the U. S waited until there is a well defined requirement before beginning research, long delays will result von Braun and York also told the committee

- Army could have placed a satellite in orbit as early as 1951 or 1952 if the program had been approved in 1946
- Three-stage Jupiter C test vehicle fired in September, 1956, that traveled 3,300 mi and reached an altitude of 680 mi, carrying a payload of 84 lb
- Russian basic research programs have obtained tremendous momentum and the U S is in danger of falling behind unless more money is made available
- Production of rockets and satellites will eventually create employment in numbers similar to automobile industry.

Space Organization

Washington—Dr Hugh L. Dryden, director of the National Advisory Committee for Aeronautics outlined last week steps already taken or scheduled to be taken, that would transform NACA into the proposed national civilian space agency

- "We are making plans with regard to our internal organization and management structure to assure that the expanded operations especially in the areas of space vehicle development and use, be promptly and efficiently undertaken Although these plans have not been finalized, they will include new elements as well as the effective operating mechanisms evolved by NACA over the past 43 years.
- "We are also planning additional actions and programs that will be necessary to assure rapid implementation of the proposed legislation This includes determination of the requirements for additional staff, facilities and funds that will be needed.
- "We have undertaken with Defense Department officials the review of pertinent space programs currently underway or planned by the department, (including) lunar probes,
- "Flight into space requires that great effort also be devoted to such problems as electronics, guidance, and physiology or human factors We plan to make substantial use, by contract, of organizations with competence already demonstrated in these related fields of technology.
- "We will discuss with the National Science Foundation and the National Academy of Sciences, as well as with other governmental and non governmental bodies participation by the scientific community on a continuing basis in the planning and coordination of scientific programs for the use of space vehicles
- "We have already shifted much of our powerplant emphasis from air breathing engines, which are now reaching an advanced state of development, to rocket engine types. These can be used not only to propel ICBMs and satellites, but to send first unmanned and then manned space craft to the moon and beyond
- "The work we are doing on structures and structural materials is now being focused on problems peculiar to missiles and vehicles that travel beyond the earth's atmosphere."

Vinson Hits Reorganization Plan; Attacks 'Ivory-Tower' Concept

By Katherine Johnsen

Washington—Legislation implementing President Eisenhower's Defense Department Reorganization Plan met with an immediate and scathing attack on the house floor last week by Rep Carl Vinson (D Ga), chairman of the Armed Services Committee and long-time keynoter of defense policy

In effect, Vinson declared, the plan would mean rule by an ivory tower Prussian-type "supreme" general staff over a defense organization of vestment subservient to a "single war concept"

Vinson's attack was followed the next day by a major address by President Eisenhower labeling as "nonsense" the charge that his plan would establish "a monstrous general staff . . . to dominate our armed forces and in due course threaten our liberty"

The President said there would be "clear-cut civilian control (of the military by) the Secretary of Defense the Commander-in-Chief and the Congress, all functioning within bounds set by the Constitution"

The President made economy through unity the top selling point for his plan "I know one sure way to overspend," he said "That is by overindulging sentimental attachments to outmoded military machines and concepts" He repeated his call for "one single basic (strategic plan) scheme under single direction"

Although the President's plan gives the Secretary of Defense sweeping authority, Vinson said that in practice he would be dominated by the general staff

"No Secretary of Defense has the ability, the knowledge, the clairvoyance, the time, the strength and the wisdom to assume the operational control of the entire military establishment," he commented and added

'Unilateral Thinking'

"The concept of this staff system is unilateral thinking at all costs There can be no room for discussion no room for debate, no room for service advocacy, no room for split papers From this system will come complete merger and, undoubtedly, an ability to fight a war based upon a single concept

"The Secretary of Defense, in the future, will have presented to him not a choice of decisions but only unilateral decisions The Congress will be told by the military leaders of the future, one philosophy of warfare and then will be asked to rubber-stamp it with an appropriation"

Hearings on the President's plan (AW April 14, p 28) and counter-legislation sponsored by Vinson, Rep Leslie Arends (R-Ill), and Rep Paul Kilday (D-Tex) will start this week before the Armed Services Committee which Vinson heads

Arends is ranking Republican on the committee and Kilday is chairman of the subcommittee on reorganization The Vinson-Arends-Kilday bill would decentralize authority and tighten the ties between the policy-deciding Joint Chiefs of Staff and operating commands (AW Mar 10, p 24)

The "great virtue" of the present Joint Chiefs of Staff, Vinson said, is that it effects "a unity of planning and command" by giving the chiefs the authority and responsibility of executing the plans as chiefs of their services

Expressing "grave misgivings" with the President's plan to have the Joint Chiefs delegate their service functions to vice chiefs reporting to the Secretary of Defense, Vinson protested that it will in effect separate the Joint Chiefs of Staff from their day-to-day role as chiefs of their services

He challenged the President's plan to expand personnel of the Joint Chiefs of Staff—now limited by law to 210—and make it an operational staff and to increase the authority of the chairman of the Joint Chiefs of Staff over it "The staff will become in a professional sense, feudal retainers dependent on pleasing the Chairman," Vinson objected

'Supreme High Command'

The President's proposal to eliminate separate administration of the three services, Vinson said, for all practical purposes, eliminates three civilian secretaries . . . and enhances the power of the Secretary of Defense. The net result is greater concentration of military control subject only to the mental and physical capabilities of one individual Secretary" Vinson declared that it is "obvious" that the Secretary's authority will be delegated to an increasingly powerful supreme command The Secretary will have nominal power"

Vinson called for "responsible decentralization as the key to efficiency" Inter service competition, he said, is a fortunate thing—that each service desires the funds necessary to fulfill their important missions in our national

Dyna-Soar Proposals

Washington—Phase I contract for the initial development of the Dyna-Soar manned orbital bomber probably will be awarded by the Air Force within a week Two contractor teams may be selected to pursue parallel designs and the final choice delayed until Phase II or the hardware stage is reached

The following companies or combinations submitted Dyna-Soar proposals to Air Force before April in response to an Air Force request made about a month earlier

- Northrop Aircraft Inc.
- Combination of North American's Columbus and Rocketdyne divisions and Minneapolis-Honeywell
- Douglas Aircraft Co.
- Convair Division of General Dynamics Corp
- Combination of Boeing Airplane Co and Chance Vought Aircraft Inc
- Combination of Martin, Bell, Minneapolis-Honeywell
- Combination of Republic, General Electric's Military and Ordnance Systems Division, Thiokol and Systems Corp of America

General Electric made no independent proposal and Westinghouse was not involved in any way although it is believed that they were invited to participate Thiokol is associated with several of the proposals other than the one submitted in conjunction with G E, Republic and Systems Corp of America

North American's Columbus Division was active in the competition rather than the Inglewood Division because of the latter's heavy design responsibilities on the WS-110 chemical bomber project

Propulsion system for the Dyna-Soar would be a three stage rocket similar to the Thor, Vanguard second stage Several of these rockets would be clustered and the glide vehicle mounted on top It would separate from the Dyna-Soar's third stage at 150 200 mi

security." Noting that Congress can base its judgment on the testimony of all the interested parties, he proposed: "Certainly this is a far better system than placing this fantastic responsibility in the hands of one non-elected individual."

Bitter Battle

Indicating that the coming fight over reorganization will be bitter, Vinson noted in his speech to the House that the President's message seeking enactment of his plan lacked "the words and spirit of mutual understanding and desire to cooperate."

"I discern in it a readiness to blame existing law, and the Congress that passed it, for the shortcomings and confusion we are told exist in our defense establishment," he told his colleagues. "But I fail to discover in any instance in the message a recognition that it is possible that even a few of our defense deficiencies are the result of a failure of leadership and direction on the part of the appointed officials in the Pentagon."

Aero Design to Become Subsidiary But Will Keep Corporate Identity

Oklahoma City–Aero Design & Engineering Co. will become a subsidiary of Rockwell Spring & Axle Co. under the terms of an agreement which calls for an exchange of stock between Aero Design shareholders and Rockwell, with the latter getting at least 82% of the business plane manufacturer's stock.

George T. Pew, chairman of the board and president of Aero Design, said the agreement provides that the aircraft company maintain a separate corporate identity as an operating subsidiary of Rockwell. He said the agreement "contemplated that the existing management group would remain in charge."

Deal is subject to approval by both stockholder groups. Aero Design's approval would seem certain since Pew is majority stockholder. Although he will relinquish control of Aero Design, Pew apparently plans to stay with the company for the time being under the agreement that present management will be retained.

Rockwell's acquisition of Aero Design will give the business aircraft manufacturer greater financial resources than it could command in its former position as a closely held company. Financial resources of the parent company will presumably help Robertson Aircraft, an Aero Design research and development subsidiary currently developing a VTOL aircraft (AW Jan. 27, p. 77).

Aero Design is building twin-engine 560E and 680 Aero Commanders and is putting the pressurized Alti-Cruiser into production. Company opened a new manufacturing facility at Tulakes Airport four months ago, after its former plant was destroyed by fire in August, 1957.

Rockwell was formed in 1953 in a consolidation of Timken-Detroit Axle Co. and Standard Steel Spring Co. Acquisition of control of Aero Design is Rockwell's second diversification move this year; it recently purchased the hydraulic drives department of Westinghouse Electric Corp.

Last year Rockwell's consolidated sales totaled \$263,503,911 and net income came to \$15,514,042, equal to \$3.20 per share. Major products include axles, bumpers, brakes and parts for trucks and buses, also tandem drive units and universal joints.

Rockwell is headed by Col. Willard F. Rockwell, Pittsburgh, who last year served as a special assistant to the Secretary of Defense.

Reconnaissance Satellite Plan

Washington–Development of a satellite capable of carrying a telescope and television equipment will be an early project of the National Aeronautics and Space Agency, the House Space Committee was told last week. The proposal was outlined by Dr. Hugh L. Dryden, director of the National Advisory Committee for Aeronautics, which will become the nucleus of NASA under bipartisan legislation now before Congress.

"One of the projects we would like to begin as quick as possible," Dr. Dryden said, "would be the development of a satellite capable of carrying in orbit an astronautical telescope and the auxiliary television equipment necessary to send to earth the pictures taken through the 'scope.

"To be able to observe the stars and the galaxies from a point in space where there would be none of the distortions caused by our atmosphere would enable astronomers to gather a wealth of new information about our universe. It is possible to construct a telescope of useful size, together with its supporting equipment, to be carried in an orbiting satellite weighing a ton or so. Stabilization of the satellite itself will be difficult but it appears that the task is straightforward."

French May Re-Order U. S. Helicopters

Paris–Additional orders for U.S. heavy helicopters by the French defense ministry may be in the offing.

Defense Department officials in Paris are receiving urgent requests from French military commanders in Algeria. To date, French have ordered 100 Vertol H-21 and 220 Sikorsky H-34 heavy helicopters.

About 70 H-21s already have been delivered to Algerian army and navy forces while some 60 H-34s are in operation there with the French air force.

French army reportedly wants at least another 30 H-21s, preferably powered by turbine rather than piston engines. These would be in addition to the 100 already ordered.

Army would also like the last batch of this initial order to include turbine powered version of the H-21.

French air force also would like additional H-34s from the U.S. This is mainly because the bulk of the H-34 order is to be handled in France under license. Until this production gets rolling, air force would like direct H-34 shipments from the U.S.

Main problem for French defense ministry is finding the dollars to underwrite any new helicopter orders.

In all, the defense ministry has about 600 helicopters on order. Besides the U.S. heavy helicopters, large orders have been placed for the French lighter craft, the Sud Aviation Alouette and the Ouest Aviation Djinn.

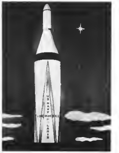
Chance Vought Plans Submarine Missile

Dallas–In an effort to broaden its sales base, Chance Vought Aircraft has made, or will make, several proposals for new missiles and missile studies to all three services.

Chance Vought has proposed a submarine missile to the Navy Bureau of Ordnance and has made its first missile proposal to the Army, R. C. Blaylock, vice president-engineering, told stockholders at an annual meeting here.

Company said that the Regulus program is progressing well and "there are strong indications that the number of Regulus II launching platforms–boats and ships–will be increased."

Report on operations in the first quarter showed a net income of \$2,312,451 on sales of \$78,401,110, compared with a \$1,010,232 profit on \$39,421,633 sales volume in the first quarter of 1957. Backlog at the end of the quarter was \$595 million, down from \$670 million at the end of 1957, but up from the \$508 million backlog at the end of the first quarter last year.



Compressed Air to Shoot Polaris From Submarine to Surface

Navy's submarine-launched Polaris IRBM will be shot from beneath sea by compressed air to 50-100 ft. altitude before ignition of missile's engine. Technique is to protect submarine from possible malfunction and explosion of solid fuel engine. Details of Polaris were revealed at Navy League Seapower Symposium in Washington, D. C. (top right). Missile is 28 ft. long, has about 58 in. base dia., weighs 28,000 lb. One-megaton warhead is about 3 ft. long, 20 in. in dia. Launching technique is being tested near San Clemente Island off Southern California. Dummies are expelled from launching tube in stationary cylinder under water (top left). Other tests are under way at San Francisco Naval Shipyard where Westinghouse Corp. is firing dummy missiles; at right, Redwood model is fired. Fleet ballistic submarine will carry fire control system developed by General Electric Co. Geo-ballistic computer will constantly plot vessel's position and furnish data relating this position and target location to fire control computers that will insert data on ship's speed, relative motion. Computer data is converted to digital form and shortly prior to firing is fed to digital computer of missile's guidance system. After launch, missile is controlled by its inertial guidance system. Guidance will consist basically of digital computer for sorting information from fire control system and a stable reference platform which provides comparison signals for correcting missile trajectory.

How Aviation Industry Fared Financially in 1957

These are figures compiled by Aviation Week from company annual reports and from independent financial reference sources.

COMPANY	SALES 1957	SALES 1956	NET EARNINGS 1957	NET EARNINGS 1956	NET EARNINGS PER SHARE 1957	NET EARNINGS PER SHARE 1956	NET EARNINGS TO SALES % 1957	NET EARNINGS TO SALES % 1956	BACKLOG 1957	BACKLOG 1956
Aerojet General	$161 011 119		$3 810 230				2 36			
Avco	111 082 077	$220 556 305	12 032 794	16 387 487	$1 38	$1 64	4 08	5 11	113 000 000	340 000 000
Bell	202 252 534	210 023 290	4 346 429	5 101 103	1 62	2 31	2 15	2 67	137 275 481	177 295 380
Boeing	1 596 300 315	1 006 356 148	38 159 707	32 134 000	5 49	4 83	2 39	3 19	2 452 000 000	3 021 000 000
Cessna	70 249 000	64 301 000	3 865 000	4 200 000	5 94	5 48	5 5	6 2	60 300 000	364 000 000
Curtiss-Wright	598 021 822	571 001 793	40 075 582	43 153 510			6 70	1 38	293 500 000	564 000 000
Douglas	1 001 266 415	1 073 515 100	30 665 252	33 322 364	8 28	8 80	2 01	3 00	1 883 610 000	2 200 000 000
Fairchild	100 021 612	155 076 154	501 311	1 954 004	11	84	3 17	1 26		187 000 000
General Dynamics	1 562 538 900	1 082 081 349	44 218 763	35 001 692	4 00	4 01	2 8	3 3	1 700 000 000	2 105 000 000
General Electric	4 335 100 000	4 080 006 000	247 000 000	213 800 000	2 84	2 46	5 7	5 2		
Grumman	205 159 921	191 304 602	5 234 774	1 102 892	2 38	2 001	2 55	3 90	250 000 000	164 000 000
Hiller	11 121 011	9 851 143	228 151	98 209			2 05	9 97	13 730 000	12 085 000
Kaman	15 385 100	12 380 865	465 132	400 222	1 29	1 19	3 00	3 22	35 000 000	
Lockheed	880 214 701	742 591 200	16 309 388	15 073 011	5 52	5 10	1 9	2	1 280 000 000	1 591 523 000
Martin	423 925 051	358 961 000	8 019 638	10 840 000	3 38	3 73	2 33	3 02	195 000 000	810 000 000
McDonnell*	325 300 000	188 100 000			6 10	4 20				
North American	1 143 787 403	915 921 913	32 084 462	28 160 981	4 33	3 59	1 72	3 14	581 000 000	1 285 000 000
Northrop†	332 115 855	283 411 936	4 985 011	11 738 764	3 28	7 80	1 5	4 0	228 000 000	281 000 000
Piper	28 618 600	25 081 000	2 723 000	3 551 000	2 94	2 74	10 4	10 1		7 102 000
Rancilan Motors	24 482 585	16 193 944	364 865	344 348	1 41	1 13	1 50	2 15		22 648 000
Republic	369 017 856	386 214 110	6,102 631	1 361 425	4 15	5 00	8 0	2 1	332,400,000	226 000 000
Ryan	10 085 081	49 909 925	1 064 259	1 256 159			3 3	2 5		92 000 000
Temco	119 160 322	90 131 219	2 511 633	2 357 261	1 00	1 35	2 11	2 58	160 000 000	100 000 000
United	1 237 919 313	952 885 142	51 306 108	37 081 193	1 96	5 87	4 2	2 9	1 975 000 000	2 300 000 000
Vaird	12 231 402	80 075 697	1 036 763	3 437 561	2 18	8 34			30 000 000	111 000 000
Westinghouse	2 009 343 770	1 325 375 771	72,652 000	3 492 001	1 18	10	5 6	2 3		

* Fiscal year ends June 30
† Fiscal year ended July 31

SEC Reports Industry Salaries

Washington—Following is a list of executive salaries, incentive awards and stock holdings as filed by aircraft companies with the Securities and Exchange Commission

BOEING AIRPLANE CO.—W M Allen, president and director $1? 100 salary $1?,?00 incentive award and 15 ?5? shares of common stock **W E Beall** senior vice president and director $85 660 salary $14 135 incentive award and 4 702 shares of common stock **F P Landeo**, vice president—manufacturing and director $46 620 salary $5 850 incentive award and 9 263 shares of common stock **J F Schaefer** vice president—Wichita division vice chairman of company and director $46 520 salary $2 200 incentive award and 3 ?6 shares of common stock **E C Wells** vice president—engineering and director $65 645 salary $10 825 incentive award and 3 172 shares of common stock **J O Yeasting** vice president—finance and director $22 100 salary $8 325 incentive award and 1 661 shares of common stock

D Corbel director 810 shares of common stock **F L Falwell** chairman of company and director no salary listed and 15 541 shares of common stock **H A Forward** director 800 shares of common stock **A L Gales**, director 626 shares of common stock **P Pigott** director 312 shares of common stock **W G Reed** director 1 384 shares of common stock **D Schmitz**, director, 4 100 shares of common stock.

NORTH AMERICAN AVIATION INC. fiscal year ending Sept 30 1957—**J L Atwood** president and director $133 000 salary $65 000 unpaid balance of incentive compensation plan award and 23 000 shares of capital stock **G B Brophy** vice president and director $68 200 salary $26 400 unpaid balance of incentive compensation plan award and 7 600 shares of capital stock **J H Kindelberger** chairman of board of directors and director $188 000 salary $72 000 unpaid balance of incentive compensation plan award and 16 000 shares of capital stock **R A Lambeth** vice president treasurer and director $68 200 salary $26 400 unpaid balance of incentive compensation plan award and 7 ?10 shares of capital stock **R H Rice** vice president and director $71 000 salary $26 400 unpaid balance of incentive compensation plan award and 7 610 shares of capital stock **J S Smithson** vice president and director $65 250 salary $20 400 unpaid balance of incentive compensation plan award and 7 200 shares of capital stock

UNITED AIRCRAFT CORP.—W P Gwinn president and director $180,500 salary and 6,?14 shares of common stock **J S Hubbs** vice chairman of company and director $180 500 salary and 3 000 shares of common stock **H M Horner** chairman of company and director $190 640 salary and $12 680 shares of common stock **W R Robbins** vice president controller and director $131 120 salary and 7 040 shares of common stock **H S Beers** director 120 shares of common stock **F B Cole** director 704 shares of common stock **J D DeWitt** director 120 shares of common stock **O Enders** director 652 shares of common stock **P M Fraser** director 098 shares of common stock **J P Ripley** director 4 200 shares of common stock **H C Shepard** director 102 shares of common stock **R L Stoddard**, director 1 644 shares of common stock

French Back Taon

Paris—French air ministry has decided to back the Breguet Taon as the possible second generation" NATO lightweight strike fighter Air ministry thus rejected the other French entry Dassault's Etendard VI French officials explain the decision was based largely on the fact that the Dassault work load is still considerable, while recent budget cuts have eliminated much of the Breguet's orders. Also, the Breguet Taon reportedly will be easier and cheaper to build than the Etendard, which required certain material obtainable only in the U S Breguet Taon presently powered by the Bristol Orpheus 3 will be powered by the Orpheus 12 in newest version

Sparrow II Missile Production Ordered

Royal Canadian Air Force and Department of Defense Production have ordered the Sparrow II air-to-air missile into production for the RCAF Air Defense Command

Canadair Ltd will produce the missile under license from Douglas Aircraft Co Subcontractors will be Aviation Electric Ltd , de Havilland Aircraft Co of Canada Ltd and Sperry Gyroscope Co

As originally developed by Douglas Aircraft Sparrow II was a solid propellant experimental missile and was not intended for operational use by United States forces

Two-Place F-106B Makes First Flight

First flight of Convair F 106B, tandem two-seat version of F 106A Delta Dart, has been completed at Edwards AFB Calif Gear is partially retracted in top photo, taken as aircraft left for 40 min maiden test flight Performance details were not revealed, other than that flight was supersonic F 106B is identical to F 106A except for second seat and longer cockpit canopy (below) Forward sections of the all weather jet fighter are fabricated at Ft Worth Tex plant of Convair Division of General Dynamics Corp and then are shipped to San Diego, Calif., for mating with remaining sections Both models are powered by Pratt & Whitney J75 turbojets producing 23,000 lb thrust (AW Sept 9 p 32)

Ground Tests Start on Vertol 107

Artist's drawing of turbine-powered Vertol Model 107 tandem rotor helicopter which is undergoing ground tests at Philadelphia International Airport. Model 107 is powered by Lycoming T53 free-shaft turbines, is about 5 ft. shorter than the H-21 (AW April 7, p. 34). Aircraft will carry about 20 persons.

Douglas Quarterly Earnings Decline

Substantially lower earnings during the rest of the year were forecast last week by Douglas Aircraft Co., which reported to stockholders that write-offs for the DC-8 jet transport doubled in the first quarter of this year compared with last.

Approaching completion of DC-6 and DC-7 production plus the DC-8 write-offs, which totaled \$16,800,000 during the first quarter, will cause the profit decline. Inventory write-down for the first DC-8, rolled out this month (see p. 102), contributed a \$2,500,000 item to the total.

First quarter earnings declined somewhat from \$8,773,000 to \$8,596,000, but sales increased from \$271 million a year ago to \$312 million. Earnings dropped from \$2.37 a share to \$2.32.

Other companies to report earnings were:

- **Vertol Aircraft Corp.** sales and earnings declined in 1957, sales from \$90,025,697 in 1956 to \$77,231,402 and earnings from \$3,437,563 to \$1,656,768. Per share earnings dropped from \$6.34 in 1956 to \$2.78 last year. Prospects for production in 1958 are modest, the company report said, but the management has confidence in the company's long term prospects.
- **American Airlines, Inc.**, reported net earnings of \$1,065,376 for the quarter ended Mar. 31, a drop of \$47,249 under a similar period last year. Total revenue for the quarter was \$71,057,403 against \$70,714,104 a year ago. Net earnings, including profit of \$570,000 from disposal of property, was equivalent of 19 cents a share on common stock.

Airline carried 1,827,027 passengers 1,145,997,000 revenue mi.

Moon Test Vehicle

Washington—First flight test of the Thor Vanguard configuration which later will be used to boost USAF's lunar probes is scheduled at Cape Canaveral, Fla. this week. Heavily instrumented vehicle not only will test separation and light-off problems but is expected to provide information useful in current military missile work.

Vehicle consists of the Thor with an Aerojet engine mounted on top. This is the engine used in the second stage of the Vanguard satellite launching vehicle.

Actual moon probe vehicle will carry a third stage. Two possibilities for the third engine are a large solid propellant unit, probably to be made by Aerojet or Thiokol, and a fluorine-hydrazine liquid propellant engine now being studied at National Advisory Committee for Aeronautics' Lewis Flight Propulsion Laboratory in Cleveland, Ohio.

American Strike Date Postponed by ALPA

Washington—Threatened strike against American Airlines by Air Line Pilots Assn. was postponed last week when both sides agreed to further mediation efforts requested by the National Mediation Board.

Pilots had set a strike date at midnight, April 16, because of charges by the union that American had failed to meet standards of its competitors in pay, rules and working conditions.

In accepting the Board's request during the final hours before the strike deadline, the Pilot union emphasized it was acceding "reluctantly." It added that the deadline was being postponed, not withdrawn.

Both American and the union met with the National Mediation Board in New York Thursday to continue discussions.

News Digest

Grumman Aircraft Engineering Corp.'s F11F-1F broke an official world altitude record by reaching 76,828 ft. Super Tiger, powered by a General Electric J79 engine, was flown by Lt. Cdr. George Watkins from Edwards AFB, Calif. National Aeronautics Assn. will submit the record to Federation Aeronautique Internationale for approval.

ACF Industries Nuclear Products-Erco Division will built 15 ton mobile launchers for Northrop SM-62 Snark missile under a \$1 million contract. Combined carrier and launcher consists of a 16 wheel chassis on which a pair of hydraulically powered jacks are mounted to raise the missile for launching.

Air Force-Navy contract totalling approximately \$10 million for "a large production volume" of T53-L-1 turbine powerplants for Bell HU-1 and Kaman H-43B helicopters has been awarded Lycoming. Engine deliveries are scheduled to begin January, 1959.

Lockheed Aircraft Employes voted to strike if necessary to support union contract demands. Strike votes have been approved at Douglas' Long Beach plant and North American. Douglas El Segundo, Torrance and Santa Monica workers met yesterday to take a strike vote. Approval is expected. Lockheed, Douglas and North American contracts all have expired, but work continues during negotiations as a result of management-union agreement.

Bristol Britannia turboprop transport has been certificated by the Paris office of the Civil Aeronautics Administration. Modifications required by the CAA were primarily in the powerplant and landing gear areas. British Air Registration Board concurred with CAA requirements for engine modifications although requirements on landing gear changes differed in several respects between the two agencies.

Lockheed F-104A and F-104Bs, including those operational at Hamilton AFB, have been released for flight after being grounded for investigation of afterburner roughness in J-79-3A engines.

Fairey Rotodyne made first transition from helicopter to autogyro flight on its 71st test flight. Aircraft climbed to 4,000 ft. and transferred power from rotor to propellers, after proceeding straight and level with rotor autorotating, power was transferred to the rotor and a vertical landing was made.

Fairchild F-27 Flies for First Time

First flight of Fairchild F 27 turboprop transport lasted 25 min 46 sec Forty passenger, pressurized aircraft is powered by Rolls Royce Dart engines and has cruise speed of about 300 mph Range is more than 1 600 mi Number of F-27s on order is 68 number on option is 25 Frontier Airlines, which has not announced any orders for the F 27, says it is now considering the F-27 and two models of the Vickers Viscount Interest is a result of capital gains legislation which permits airlines on mail subsidy to retain capital gains profits from the sale of aircraft if the profits are used to purchase additional aircraft (AW Sept. 16, p 45). Frontier is currently operating Douglas DC-3s.

New Routes Proposed for Three Lines

Washington—The Civil Aeronautics Board's Bureau of Air Operations has recommended new route segments for National and Eastern Airlines and Southern Airways in answer to a Defense Department request for better air service to four of the nation's most important military bases

Defense Department filed a motion to expedite portions of the complicated South East Local Service Case in the interests of national defense Specifically the military asked improved service for Huntsville, Ala (Army Ballistic Missile Agency and Army Rocket and Guided Missile Agency) Eglin AFB, Fla (Air Proving Ground Center), Patrick AFB, Fla, USAF Missile Test Center and Ft McClellan, Anniston, Alabama.

Council Recommendations

Bureau Counsel V Rock Grundman recommended that National serve Melbourne Fla, near Patrick The Defense statement said Patrick could easily provide 22,000 passengers a year for two carriers National would serve Melbourne via the intermediate points of Tampa and Eglin to provide improved service to New Orleans

Eastern would serve Melbourne as an intermediate point between Vero Beach and Orlando

Southern Airways was recommended to serve Huntsville as an intermediate point between Memphis and Atlanta Ft McClellan as an intermediate point between Gadsen, Ala, and Atlanta and Eglin AFB as a point on Route 98 between Panama City, Fla, and New Orleans

Local Service Opposition

If approved by CAB these recommendations could provide the military with their greatest need in the areas mentioned—better air service connections between research centers and manufacturers located both on the West Coast and the Detroit area

However, many local service carriers can be expected to oppose the recommendations Trans Texas Airways has filed a brief with examiner Paul N Pfeiffer requesting Huntsville on the grounds that the airline could operate a new segment without subsidy and, using maximized DC-3s offer faster service than could be provided by Southern

To substantiate its "no subsidy" position Trans Texas cited present operating costs per plane-mile of 103.30 cents "as compared to Southern's 115.79 cents"

Southern admits it would need extra subsidy for the route and estimates that the annual cost of operating the route would be $126,144 A load factor of 35% over the route would pay all direct operating costs Southern said

The cities affected by the recommendations are only those considered as vital to national defense and requiring immediate action Defense Department had earlier included such points as Ft Rucker, Ala, Turner AFB Albany, Ga, and the Arnold Engineering Development Center, Tullahoma, Tenn., in the overall South East Local Service Case

Route 87 Extended

Bureau Counsel Grundman also has notified the Tennessee Bureau of Aeronautics that Piedmont Airlines will be recommended to the examiner to serve that state by extension of its Route 87 to serve a Tri-Cities-Memphis route through the intermediate points of Knoxville Chattanooga Tullahoma and Shelbyville, Nashville and Jackson

Southeast Airlines has applied for a Huntsville-Memphis route on the basis that it already provides the most flights from Memphis and could thus offer the best service to all Tennessee gateways and Tullahoma

The local service airline said it can operate all of the routes without any subsidy aid

Airlines, Curtiss-Wright Tackle Problems of Turbo-Compound

By L. L. Doty

Washington—Wright Turbo-Compound is the target of mounting criticism from airline and engineering officials who charge that the engine's record of premature failures and frequent removals falls short of their standards needed for airline performance

The Wright engine, because of its low specific fuel consumption, has provided the airline industry with a range characteristic that has permitted polar and regularly scheduled nonstop transcontinental and transatlantic flights for the first time Most operators agree that the engine has made a major contribution toward the speed and range that passengers want and will buy

According to one spokesman for the manufacturer Wright Aeronautical Division of Curtiss-Wright Corp the airlines have 'made money' on the engine for this reason Airline sales officials agree that the engine has given them a product that is a potent sales tool

The engine however, has become the subject of bitter criticism from airline maintenance and engineering personnel who are forced to maintain reliable schedules in the face of what one line vice president termed a "dismal engine record

The Wright R-3350 has undergone a teething period similar to that experienced with the Pratt & Whitney R-4360 by operators of the Boeing 377

CAA Records

For example, Civil Aeronautics Administration records—compiled from data submitted voluntarily by airlines—show that U S carriers last year experienced one removal of Wright R-3350 Turbo-Compound for every 1,960 engine hours of operation In one three month period, CAA records indicate that operators of the Douglas DC-7B powered by the Wright 18 cylinder Turbo-Compound engine reported 334 feathered propellers, or one feathered propeller for every 1,472 engine hours

Wright engineers are optimistic that the engine will reach a high degree of reliability "within a matter of months" They are conducting an active program designed to assist airline personnel in eliminating current problems by sending "audit" teams of three or four key engineers to consult with airline managements on the engine

Last week, teams were headed for Delta Air Lines and KLM Royal Dutch Airlines to talk with flight crews, maintenance and overhaul personnel and top-level management

There have been encouraging signs recently that some progress is being made toward improving the engine's performance Latest CAA records on the engine show one engine failure for every 2,500 engine hours An estimated 43% of the engines reached full overhaul time without any intermittent removal during the period from August 1 to January 1, an improvement over previous records but far from goals airline engineers are striving to reach

One airline official told AVIATION WEEK that causes of engine failures have not followed any established pattern which, he added, has been an obstacle in overcoming the engine's flaws since troubles can not be traced to an anticipated source In a survey of the carriers by AVIATION WEEK, it was discovered that reasons for engine failures vary widely according to operational demands placed on the engine such as length of haul climatic conditions or schedule frequency

Some problems have been common to most airlines, however, and a number of these problems have been licked The impeller drive which during 1957 was the source of an estimated 19% of the engine failures reported to the CAA, is no longer causing major problems since the issuance of an airworthiness directive in February 1957 requiring the installation of new parts

Now that necessary modifications of the unit have about been completed, impeller drive malfunctions have declined sharply Last February, troubles in this area had all but disappeared

Wright Aeronautical contends that many engine problems stem from failure of the airlines to maintain overhaul and operate the engine according to design standards The company says that the airlines often refuse to accept recommendations for corrective action and adds that it can only suggest areas that should be investigated rather than actively participate in establishing overall procedures

Biggest problem to the majority of carriers now lies in the combustion chamber units, although at least one airline reports only minor trouble in this area As of Jan 1, an estimated 54% of the engine failures reported to the CAA were due directly to combustion chamber malfunctions

Although cylinder flange failures were an original source of difficulty, this problem has been largely corrected and most combustion chamber trouble can now be traced to cylinder barrel failures Majority of such failures start from the inside and work out, resulting in cracks on the barrel surface

In almost every recent cylinder failure, maintenance personnel have detected a scuffed barrel that can be caused by detonation lack of lubrication or rings that have been fitted too tightly

Some airlines, concerned at the high rate of oil consumption of the engine fitted the rings tighter than the standard fit recommended by Wright Aeronautical Division in a move to conserve oil In addition a number of airlines replaced the cast iron ring in No 2 groove with a chrome plated ring in hopes of cutting oil consumption

The tight fit forced the rings to take all the thrust loading to result in a scuffed barrel This would cause a stress raiser which, in turn would result in engine failure

Electra Engineers

Los Angeles—New long term labor agreement guaranteeing the services of professional flight engineers aboard the fleet of Lockheed Electra turboprop aircraft to be placed in service next year by Western Air Lines was signed by company representatives and the Flight Engineers International Assn.

Effective immediately, contract is renewable on Jan 1, 1961 In addition to guaranteeing assignment of FEIA engineers to Electra crews the labor agreement also provides for increased pay, expense allowances and vacations, as well as improved working conditions.

Under terms of the pact, Western agreed to hire flight engineers who hold in addition to the presently required flight engineer's certificate an airline mechanic's license. Exceptions can be made for university engineering graduates.

Key section of the agreement provides special rules for Electra training for flight engineers

Corrective Maintenance

To combat the combustion chamber problem, most airline operators have now adopted these maintenance measures

- **Procedures for fitting rings to proper** clearance measurements are being adopted by the carriers
- **Chrome plated ring is being removed** from No 2 groove Under the original engine design only the No 1 groove is to be fitted with the chrome ring Since scuffing is attributed to the chrome ring in the No 2 groove, carriers are returning to the cast iron ring for this position, even though oil consumption will be increased However Wright is introducing a new cast iron ring designed with steeper angles that it claims will reduce oil consumption
- **Rougher finish is being applied** to cylinder barrels as a means of reducing scuffing A cross-hatch lapping is recommended by Wright in preference to the vertical lapping now used Carriers have been advised by the CAA to clean the barrel with a mechanical brush and sufficient cleaning fluid after each lapping
- **Checks have been adopted on** individual piston oil squirts to determine if they are open and functioning properly to prevent starving the barrel
- **Procedures are being used to check** piston dimensions to avoid high spots that will cause high unit loading on piston skirts

Trouble with cam and cam drive assemblies was responsible for 10% of the engine failures reported to CAA last year Major problem at present is one of wear and a high replacement rate of parts Carriers are still plagued with problem of valve springs breaking

Valve failures reported to the CAA during February indicate the possibility of an increase of trouble in this area However, internal torque meter failures, once a significant cause of difficulty, have been almost eliminated

Malfunctions of the rear section assembly accounts for 3% of the total engine failures, according to CAA records Chief concern with this assembly was due to bushings breaking loose and spinning in the lower accessory drive case Carriers plan to use bronze bushings instead of aluminum alloy bushings as a means of correcting this difficulty

Overheating of the power recovery turbine units is still a source of concern to the airlines Overheated shafts will stretch, causing the nut that holds the entire assembly to lose its tightness This causes the wheel to jiggle on the spline and results in a breakage

Prior to Civil Aeronautics Administration approval of the engine four years ago, turbine blades would break through the casing, resulting in damage to areas beyond the engine, including fuselage and propellers The engine was certificated for civil use when the casing was armor-plated as a means of containing the broken blades Armor plating, which created a weight sacrifice has been eliminated Now, four blades of the turbine are triggered to fail when rotation of the turbine wheel accelerates at 25,000 rpm Normal rate is about 19,000 rpm, and blades will usually break through a casing that is not armor plated at 35,000 rpm When the blades are triggered to fail at 25,000 rpm, all blades are cut and destroyed by the four free blades before the runaway turbine wheel reaches the danger rotation

Here are steps being taken by most carriers to maintain proper coolness in the PRT

- **Minimum speeds of 170 knots** must be maintained to insure proper coolness of the PRT Noise abatement programs set at a number of airports contribute to overheating since the high rate of climb necessary to conform with noise restrictions will lower speeds below the 170 knot minimum
- **Turbine clearance** must be properly maintained Some carriers avoided recommended clearances in order to prevent wear

It is on such issues as turbine clearance that Wright Aeronautical and the airlines have not seen eye to eye Wright engineers charge the carriers with failing to conform with established overhaul procedures One Wright official said that "if the carriers violate or exceed standards trouble must be expected"

Airlines counter that deviation from standards—or experimentation with the engine—has been necessary to solve problems encountered with the engine They point to tests with cylinder ring fittings as an essential move in reducing oil consumption to an acceptable level

Some carriers are more vehement in their criticism of the engine than others This is due primarily to a wide variety of performance results with the engine by individual airlines For example in the third quarter of 1957 one airline reported one engine failure every 6,291 hours with a fleet of DC-7Cs, while another carrier's record was one failure every 1,241 hours with the same airplane

Bonanza Approved For Guaranteed Loan

Washington—Bonanza Airlines last week became the first local service carrier to obtain a government backed loan for equipment purchase in accord with legislation adopted by the Civil Aeronautics Board last September

Announcement of the loan approval was made by CAB Chairman James R Durfee in conjunction with a regional meeting of the Assn. of Local and Territorial Airlines in Las Vegas Nevada

Under the loan agreement CAB will underwrite a 90% guarantee on a $4,324,500 loan for Bonanza through the First National Bank of Nevada The airline will purchase six Fairchild F-27s for December delivery

Board approval is expected to touch off a series of similar requests from other local and territorial carriers, according to Joseph P Adams, former Board member and now executive director of ALTA Adams estimates that nine of ALTA's 10 members will apply for loans—Wien Airlines of Alaska probably next in line with a request to finance the purchase of two F-27s

Durfee's announcement of the Bonanza loan approval coincided with a review of CAB plans to aid the local and territorial service carriers

Durfee said the Board's present rate making methods were formulated primarily to handle trunkline subsidies and failed to aid local service airlines in their attempts to gain financial stability He said CAB's basic objective is to provide definite subsidy standards for the carriers to allow them the freedom of conducting operations under their own managements

Airport Aid Opposed By Administration

Washington—Eisenhower administration is opposing a Democratic drive in Congress for a $75 million "emergency fund" for airport construction

The measure, also would extend the federal aid airport act by four years and increase the annual federal allocation from $63 million to $100 million The present act expires June 30 1959

Louis Rothschild, Under Secretary of Commerce for Transporation, told the Senate Commerce Aviation Subcommittee last week that the administration's position is that airport development financing should be left to local communities

He pointed out that the federal government already has spent about $2 billion in airport development and over the next five years will be called upon to finance a $3 billion air traffic control system

Noting that the Democratic-supported proposal would cost a total $500 million, Rothschild said

"We believe that other answers can be found besides the easy one of asking the federal government to add this enlarged cost to its already substantial contribution to civil aviation in other areas such as navigation facilities and air carriers subsidy

"The construction, maintenance and operation of our civil airports has always been primarily a matter of local responsibility Airports are community assets They attract business and make possible increased tax income to the communities they serve . . . More and more communities are finding sources other than federal aid through which to finance economically necessary and desirable airport development"

Sen Mike Monroney (D-Okla), chairman of the aviation subcommittee charged that the administration was singling out aviation as the "victim" of its economy policies and giving favored treatment to other transportation industries

Sen Frederick Payne, of Maine, Republican member of the subcommittee who joined Monroney and other Democratic senators in sponsoring the airport measure told Rothschild that he was "disappointed" in the administration's position

BOAC's First Comet 4 Rolls Out

First of 19 Comet 4 jet transports under construction for British Overseas Airways Corp is rolled out at de Havilland Aircraft Co assembly plant at Hatfield England Aircraft which next will get fuel flow check and engine runs has four Rolls-Royce Avon engines of 10 500 lb thrust each Engines are fitted with Rolls-Royce end cone noise suppressors (AW Jan. 13, p. 96)

Executive Pay, Bonuses for '57 Reported to CAB by Airlines

Washington—Following is a list of airline officers and their salaries bonuses and indirect compensation expenses and stock holdings paid airline officials for the year ending Dec 31, 1957 as reported to the Civil Aeronautics Board The list also includes compensation paid by the airlines for services rendered

Trunk Airlines

Pan American World Airways Inc—J T Trippe, president and director $28 000 salary no bonus $13 040 expenses paid by company and 37 164 shares of common stock held in the name of others **J C Leslie** vice president and director $35 000 salary $2 000 bonus and indirect compensation $12 642 expenses paid by company and 5 754 shares of common stock **S F Pryor** vice president assistant to president and director $32 000 salary $404 bonus and indirect compensation $18-212 expenses paid by company and 11 582 shares of common stock **H J Friendly,** vice president general counsel and director $33 000 salary $1 000 bonus and indirect compensation $1 058 expenses paid by company and 8 800 shares of common stock.

W T Harrison, executive vice president—Latin American Division $36 000 salary no bonus $2 324 expenses paid by company and 11 902 shares of common stock **H E Gray,** executive vice president—Atlantic Division $30 000 salary no bonus $2 5 0 expenses paid by company and 6 094 shares of common stock **R B. Murray Jr** executive vice president—Pacific Alaska Division $31 980 salary no bonus $48 151 expenses paid by company; **R Lewis,** executive vice president—development and defense and director $36 000 salary $1 000 bonus and indirect compensation $5,512 expenses paid by company and 200 shares of common stock **F Gledhill** vice president and director $34 000 salary $1 000 bonus and indirect compensation $8 235 expenses paid by company and 4 900 shares of common stock **W G Lipscomb,** vice president—traffic and sales $34 000 salary no bonus $6 818 expenses paid by company and 3 495 shares of common stock **A P Adrian** vice president $28 000 salary no bonus $6 875 expenses paid by company and 2 651 shares of common stock **E Balluder,** vice president $28 000 salary no bonus $2 295 expenses paid by company and 14 825 shares of common stock **C M Young** vice president $30 677 salary no bonus $11 241 expenses paid by company and 4 125 shares of common stock **H B Adrian** vice president $20 000 salary no bonus $6 235 expenses and 2 000 common shares.

J B Gates vice president—finance $31 750 salary no bonus no expenses and 100 shares of common stock **A Kelly** vice president—Europe $18 336 salary no bonus $1 271 expenses paid by company and 1 408 shares of common stock **H W Toomey** vice president—Brazil $20 000 salary no bonus $4 361 expenses paid by company and 325 shares of common stock **R H Becker** vice president—services supply $25 130 salary no bonus $3 707 expenses paid by company and 2 565 shares of common stock **E M Gonhard** vice president—industrial relations $19 000 salary no bonus $5 049 expenses paid by company and 475 shares of common stock **R S Mitchell,** vice president—guided missiles range division $23 867 salary no bonus $7 465 expenses paid and 137 common shares.

R G Ferguson treasurer $25 000 salary no bonus $3 140 expenses paid by company and 2 959 shares of common stock **J S. Woodbridge,** comptroller, $25 000 salary, no bonus $3 220 expenses paid by company and 3 100 shares of common stock **R P Morris,** secretary and general attorney $14 000 salary no bonus, $127 expenses paid by company and 2 250 shares of common stock **S R Kauffman** assistant vice president engineering $19 000 salary no bonus $1 946 expenses paid by company and 950 shares of common stock **W W Lynch,** assistant vice president—communications $22 858 salary no bonus $1 758 expenses paid by company and 1,887 shares of common stock **J C. Carr,** assistant vice president $16 000 salary no bonus $17 646 expenses paid by company and 7,271 shares of common stock

W J McEvoy assistant vice president $18 000 salary no bonus $12 485 expenses paid by company and 3 708 shares of common stock **R P Moore** assistant treasurer $16 000 salary no bonus $1 444 expenses paid by company and 1 639 shares of common stock **J R McGuire** assistant comptroller $15 000 salary no bonus $2 780 expenses paid by company and 184 shares of common stock **E. L Rolbreck,** assistant secretary $12 000 salary no bonus $2,773 expenses paid by company and 31 shares of common stock **J. Maes Jr** assistant secretary $13 250 salary no bonus $31 expenses paid by company and 30 shares of common stock **J J Cantwell** assistant secretary $9 500 salary no bonus $1 100 expenses paid by company and 34 shares of common stock

R B Bixby director no salary $3 000 bonus and indirect compensation $1 151 expenses paid by company and 8,095 shares of common stock **N Chrysler** director no salary $700 bonus and indirect compensation $1,335 expenses paid by company and 1 000 shares of common stock **R V Fleming** director no salary $1,200 bonus and indirect compensation $236 expenses paid by company and 200 shares of common stock **M Griswold** director no salary $1 700 bonus and indirect compensation $810 expenses paid by company and 400 shares of common stock **R. L. Ireland** director no salary $1 300 bonus and indirect compensation no expenses and 1 000 shares of common stock **R W Howard** director no salary $1 400 bonus and indirect compensation, no expenses and 300 shares of common stock.

D S Ingalls, director, no salary $1,500 bonus and indirect compensation $1 605 expenses paid by company and 2 344 shares of common stock, **R Lehman** director no salary $1,100 bonus and indirect compensation no expenses and 600 shares of common stock **E. G McDonnell,** director no salary, $5 600 bonus and indirect compensation, $1,224 expenses paid by company and no stock **M. T McKee** director no salary, $5 000 bonus and indirect compensation, $7 536 expenses paid by company and 200 shares of common stock **J S Rockefeller** director no salary $800 bonus and indirect compensation no expenses and 200 shares of common stock **V F Taylor,** director no salary no bonus $3 023 expenses paid by company and 2,500 shares of common stock **W H Standley** director no salary no bonus, no expenses and 2 000 shares of common stock

Paul Aiken, Air Mail Traffic Consulting Service, $14 400 **E. L Barnes,** architect $60,247 **Chester Churchill** architect $64,260, **Cleary Gottlieb Friendly & Hamilton,** legal services $40 500 **Dewey, Ballantine, Bushby, Palmer & Wood** legal services $16,000 **Dickie Raymond Inc** sales promotion and advertising counsel $21 600 **Lehman Bros,** counselling service in connection with loan agreements $75 000 **Lexwood Service** public relations counsel $18 000 **Arthur D Little Inc.** management counsel $71,307 **Loomis Suffern & Fernald,** accounting service $47-800 **L A Mayberry** labor relations consulting $22 750 **Miles & Stockbridge,** legal service $17 200

R D Reynolds legal service $19,350 **Sanderson & Porter** engineering service, $18 740 **Skadden Arps, Slate & Timbers,** legal services, $34,268 **J A. Stearns** construction consultant $18,658, **Steptoe & Johnson,** legal services, $36,230

United Air Lines Inc—W. A. Patterson, president, $100 000 salary, $8,266 expenses paid by company and 16 008 shares of common stock **R E Johnson,** vice president—assistant to the president, $60 000 salary $9 784 expenses paid by company and 3,200 shares of common stock **J A Herlihy,** vice president—engineering and maintenance, $50 000 salary $2 030 expenses paid by company and 3 750 shares of common stock **D F Magarrell,** vice president—transport services, $50 000 salary $4 827 expenses paid by company and 1,071 shares of common stock.

D R Petty vice president—flight operations, $40 000 salary $6 158 expenses paid by company and 1 943 shares of common stock **C. Barker,** vice president—finance and property $45 000 salary $2 863 expenses paid by company and 2 659 shares of common stock **R F Ahrens,** vice president—personnel $37 000 salary $4 725 expenses paid by company and 2,630 shares of common stock, **R E Nourse,** vice president—economic controls, $31 000 salary, $1 710 expenses paid by company and 3,550 shares of common stock.

B. W Ireland vice president—traffic administration $18 700 salary $2 724 expenses paid by company and no stock **C F McErlean** vice president and assistant to the president, $30 000 salary, $1,590 expenses paid by company and 1 237 shares of common stock **S P Martin** secretary and assistant to the president, $19 000 salary $1 021 expenses paid by company and 589 shares of common stock **R Broan** comptroller $21 400 salary $871 expenses paid by company and 410 shares of common stock **A M Devoursney,** treasurer and assistant secretary $22 400 salary $1 517 expenses paid by company and 515 shares of common stock **M C Ansorge,** director, $1 700 salary $1 050 expenses paid by company and 745 shares of common stock

P A Dinsinger, director $1 800 salary $900 expenses paid by company and 550 shares of common stock **R T Brown,** director $1,300 salary $1 200 expenses paid by company and 614 shares of common stock, **G Cowles** director $1,500 salary $750 expenses paid by company and 1 072 shares of common stock **J W Dart** director $1 700 salary, $1 050 expenses paid by company and 12,010 shares of common stock **T F Gleed** director $1 800 salary $1 200 expenses paid by company and 144 shares of common stock, **P G Hoffman,** director $1 700 salary, $1 050 expenses paid by company and 170 shares of common stock, **E. A Johnston,** director, $1 700 salary, $1 050 expenses paid by company and 9 142 shares of common stock.

J J Mitchell director, $1 500 salary, $900 expenses paid by company and 4 501 shares of common stock **A Nielsen** director $1 700 salary, $1 000 expenses paid by company and 500 shares of common stock **V Stouffer,** director $1 000 salary $200 expenses paid by company and 050 shares of common stock.

Arthur Andersen & Co., audit services $31 873 **Raymond Loewy Associates Inc,** designing services, $242 436 **Mayer, Friedlich Spiess Tierney, Brown and Platt** legal services, $273 231, **James L. Reilly,** legal services, $93 336, **Skidmore, Owens and Merrill,** architect and engineering services $152,260 **Young Richardson and Carleton** architect and engineering services $28 837

Western Air Lines Inc—T C Drinkwater president and director, $65 000 salary, $9 256 expenses paid by company and 8 948 shares of common stock **S R Shallo** vice president-property and director $58 207 salary $1 010 expenses paid by company and 3 518 shares of common stock **M W Landes,** vice president-service and director $20 267 salary $633 expenses paid by company and 1 500 shares of common stock, **P E Sullivan,** vice president-administration and secretary, $30 166 salary, $1,243 expenses paid by company and 6,112 shares of common stock, **A F Kelly,** vice president-sales $30 166, $8 035 expenses paid by company and 3,708 shares of common stock. **J. J. Taylor,** vice president and treasurer, $30 166 salary $805 expenses paid by company and 2 271 shares of common stock.

D P Renda, vice president-legal $30 166 salary $1 310 expenses paid by company and 1 102 shares of common stock **G G Reneder,** vice president, $72 867 salary $5 412 expenses paid by company and 1 404 shares of common stock **C J J. Cox,** controller and assistant treasurer $22 667 salary $500 expenses paid by company and 1 200 shares of common stock **E. R Reowe,** assistant secretary and director of personnel $15 000 salary $370 expenses paid by company and no stock, **W S Barlmes** director $500 salary no expenses and 8 815 shares of common stock **G Y Billard** director, $400 salary $1 030 expenses paid by company and 1 881 shares of common stock **R W. Darling** director, $500 salary no expenses and 2 200 shares of common stock.

R E Driscoll, Sr., director, $400 salary, $37 expenses paid by company and 540 shares of common stock **W H Gonyea,** director, $300 salary $38 expenses paid by company and no stock **H C Knight** director, $600 salary, $157 expenses paid by company and no stock **G Lowry,** director, no salary, no expenses and 510 shares of common stock **Dr R H McLaughlin,** director, $400 salary, no expenses and 100 shares of common stock **L W Fogue,** director, $300 salary $100 expenses paid by company and 1 135 shares of common stock **J. F Ringland,** director, $200 salary, no expenses or stock **D Swim** director $400 salary $140 expenses paid by company and 3 257 shares of common stock

R J Volk director $600 salary $35 expenses paid by company and 100 shares of common stock, **J M Wallace,** director, $500 salary no expenses and 100 shares of common stock **A Warden,** director, $400 salary no expenses and 100 shares of common stock **S F Woodbury,** director $400 salary, $30 expenses paid by company and 140 shares of common stock.

Pogue & Neal, legal services, $15,770; **Darling Shattuck & Edmonds,** legal services $12 514 **G K Griffin** management consultant $10 162, **Burke, Reber & Nicolais,** architect services $10 380 **Buchanan & Co.** advertising services, $507 932, **Ralton Barton, Durstine & Osborn Inc** advertising services $338 030 **Smalley, Levitt & Smith,** advertising services $14,652.

Local Service Airlines

Allegheny Airlines Inc.—L. O Barnes president and director, $25 000 salary, $1,620 expenses paid by company and 30,-900 shares of common stock, **W J. Short** vice president and treasurer $14 575 salary $971 expenses paid by company and 250 shares of common stock **E. K Arnold** vice president and secretary, $13 300 salary $1,479 expenses paid by company and 6 000 shares of common stock **D L. Miller** vice president—traffic and sales, $14 050 salary $1,075 expenses paid by company and 1 202 shares of common stock **R G Dinning,** vice president and assistant to president $12 925 salary $369 expenses paid by company and 400 shares of common stock **W D Ray,** assistant controller $7 700 salary $086 expenses paid by company and no stock **G F Gerib,** assistant treasurer $7 500 salary $46 expenses paid by company and 100 shares of common stock

J S Russell Jr., assistant secretary, no salary, no expenses and 800 shares of common stock **E M Love,** chairman of board no salary $33 expenses paid by company and 2 000 shares of common stock **C Bidermacher,** director, no salary no expenses and no stock **R F George,** director no salary $1 022 expenses paid by company and 52,208 common shares

H O Hale director, no salary no expenses and 2 500 shares of common stock **R V Maloe** director no salary no expenses and 4 300 shares of common stock **W F Rockwell Jr** director no salary no expenses and 7 000 shares of common stock **R A Shalterwhite,** director no salary no expenses and 7 575 shares of common stock **H R Skorp Jr** director no salary no expenses and 1 700 shares of common stock **H A Tompkins Jr,** director no salary no expenses and 100 shares of common stock **W R Waldeirn** director no salary no expenses and 4 500 shares of common stock **H M Thompson** director of flying operations $15 050 salary $893 expenses paid by company and 30 shares of common stock.

Hale Stimson, Russell & Nickerson legal services, $21 010, **R Dixon Speas,** maintenance survey $11 000 **Albert, Frank-Guilerie Law Inc,** public relations $7 108

Bonanza Air Lines Inc.—E C Converse, president and director $17 000 salary, $1 022 expenses paid by company and 205-286 shares of common stock **L G McNeil** chairman of board no salary $593 expenses paid by company and 05 237 shares of common stock **G R Hrory,** executive vice president, $14 667 salary, $3,264 expenses paid by company and no stock **F J. Murphy,** vice president, secretary and director, $11 667 salary, $1 881 expenses paid by company and 10,102 shares of common stock.

M W Reynolds, vice president—operations, $15 234 salary, $1,651 expenses paid by company and no stock **W J Mitchell** vice president—sales $10 500 salary $4 140 expenses paid by company and no stock **R R Herrstein** vice president and treasurer $11 535 salary $825 expenses paid by company and no stock **E C Jerbim** comptroller and assistant secretary $10 434 salary $1,570 expenses paid by company and no stock **R. J Sherrer,** treasurer $10-056 salary $2 050 expenses paid by company and no stock, **J Arani** assistant to the president $6 250 salary $6 877 expenses paid by company and no stock **D R Nyllane** assistant comptroller $6 950 salary $603 expenses paid by company and no stock **V M Greer** assistant secretary $5 500 salary no expenses and no stock **W C Bori** assistant secretary no salary $20 expenses paid by company and no stock.

F W Borr director no salary no expenses and 4 875 shares of common stock **R Converse** director no salary $181 expenses paid by company and 10 000 shares of common stock, **J R Basen** director no salary no expenses and 8 000 shares of common stock, **G L. Vargas,** director no salary no expenses and 1 770 shares of common stock.

Roleen & Hart legal services $22 150 **Albert Grissard** legal services $14 006, **Peat, Marwick Mitchell & Co.,** auditors $12 352

Central Airlines Inc.—R. Rahle, president $15 550 salary $2 863 expenses paid by company and 20,120 shares of common stock, **F R Howe,** executive vice president and treasurer $14 550 salary, $3,702 ex-

penses paid by company and 500 shares of common stock; R. L. Wagenerk vice president—operations, $12,010 salary $421 expenses paid by company and no stock; A. S. Aldridge, vice president—traffic and sales $10,554 salary, $1,692 expenses paid by company and 1,910 shares of common and eight shares of preferred stock; C. E. Landstrom, secretary and assistant treasurer $8,458 salary, $172 expenses paid by company and 33 shares of common stock; A. H. Pritchett, assistant secretary $6,019 salary $15 expenses paid by company and 175 shares of common stock; B. Gahagan assistant secretary $4,477 salary no expenses and 131 shares of common stock.

P. Crawford assistant secretary, $275 salary no expenses or stock; F. K. Johnson chairman board of directors $2,250 salary $179 expenses paid by company and 143,209 shares of common stock; Pogue & Neal, attorneys, $11,575; Mueller & Moeller, labor consultant, $8,141; Air Market Associates, research $11,059; Advertising Counsellors, advertising services $0,636.

Chicago Helicopter Airways Inc.—J. S. Gleason Jr. president treasurer and director $12,000 salary; C. W. Moore, executive vice president and director $17,500 salary and $2,500 bonus and indirect compensation; R. B. Kiel, assistant secretary-treasurer $10,500; R. S. Angstadt, vice president—operations, $14,000; J. C. Brogan vice president secretary and director $6,000 directors W. Kirkland, J. P. Hingley, P. A. Pedesto and F. B. Schmick received no compensation; Kirkland Fleming, Green Martin & Ellis legal services, $6,811; Pogue & Neal legal services $3,080; Hayes Statistical Services Inc. statistical services $5,100.

Frontier Airlines Inc.—A. J. Frank, director, no salary and 3,765 shares of common stock; C. A. Myhre president and director, $31,878 salary and $4,335 shares of common stock; E. N. Levin, secretary and director, $7,800 salary and 13,643 shares of common stock; L. W. Lievitte director no salary and 650 shares of common stock; E. B. Slocum, director no salary $4,500 bonus and indirect compensation and no stock; B. Regan chairman board of directors no salary and 208 shares of common stock; J. E. Wagner, director no salary and 400 shares of common stock; P. Walker director no salary and no stock; J. D. Lindsay, vice president—sales $12,500 salary and 1,000 shares of common stock; L. P. Bisticc treasurer $12,000 salary and 150 shares of common stock; E. W. Sexton, Jr., assistant treasurer $7,200 salary and no stock.

Bowen & Stoull legal services, $23,240; E. Shields Hewitt & Associates actuary $5,582; Cella Hugh McIntosh economic counsel $6,243; G. W. Shoemaker economic counsel $5,000; Rippey, Henderson, Bucknum & Co., advertising agency, $148,796.

Lake Central Airlines Inc.—G. Hicks, president, $16,000 salary $6,510 expenses paid by company and no stock; L. W. Hartman executive vice president and treasurer $12,000 salary $275 expenses paid by company and no stock; R. W. Clifford, vice president operations $12,000 salary, $773 expenses and 339 shares of common stock.

Los Angeles Airways Inc.—C. M. Belinn, president $22,500 salary $8,560 expenses paid by company and 7,271 shares of common stock; J. T. Kane treasurer, $10,000 salary $1,500 expenses paid by company and no stock; J. C. Lombardi director $150 salary no expenses or stock; W. C. Jordon director $150 salary, no expenses and 240 shares of common stock; O'Grady & Marshall legal services $6,415.

Bucke, Williams & Sorensen legal services, $5,480 paid in 1957 and $8,948 accrued in 1957.

New York Airways Inc.—R. L. Cummings Jr. president and director $18,136 salary $11,212 expenses paid by company and 1,000 shares of common stock; H. Brock vice president and director $15,134 salary $1,734 expenses paid by company and 450 shares of common stock; J. E. Gallagher vice president $13,711 salary $4,095 expenses paid by company and 250 shares of common stock; W. W. Hogue

Soviet STOL An-14 Makes First Flight

Soviet An-14 Pchelka (Little Bee) general purpose monoplane designed by O. K. Antonov is undergoing short-range flight test at low altitudes. Aircraft is designed to take off and land on any open area from approximately 160 to 340 ft. in length. Aircraft, proposed for use as an agricultural or ambulance vehicle, and as a short-haul transport, is equipped for instrument flying. As a transport, the aircraft can seat seven. Leading edges of vertical tail surfaces are swept back on aircraft depicted here; leading edges of vertical tail surfaces of mockup were perpendicular. The An-14 has a maximum speed of 124 mph. and a landing speed of 22 mph. Pchelka is expected to be well suited for operating from Russia's more primitive airfields (AW Nov. 4, p. 61).

treasurer, $10,070 salary, $2,092 expenses paid by company and 100 shares of common stock; **J. B. Slair,** secretary, no salary, $32,000 bonus and indirect compensation received from Slate's law firm, no expenses or stock; **G. B. Eastbaro,** assistant to president and assistant treasurer, $9,723 salary, $2,090 expenses paid by company and 100 shares of common stock; **G. L. Glyen,** assistant treasurer, $7,303 salary, $540 expenses paid by company and 100 shares of common stock; **A. Fallon,** assistant secretary, $4,429 salary, $50 expenses paid by company and no stock; **H. Amsaidon,** director, $25 salary, no expenses or stock; **R. E. Blum,** director, $175 salary, no expenses or stock; **R. W. Dowling,** director, $50 salary, no expenses or stock; **F. M. Glass,** director, $160 salary, no expenses or stock; **R. G. Goelet,** director, $125 salary, no expenses and 2,200 shares of common stock; **K. Ide,** director, $100 salary, no expenses or stock; **G. Leesing,** director, $150 salary, no expenses and 5,000 shares of common stock; **S. C. Park,** director, $100 salary, no expenses or stock; **W. Shields Jr.,** director, $150 salary, no expenses and 200 shares of common stock; **George Doly Associates,** public relations, $12,134; **The Chartmakers Inc.,** annual reports and charts, $5,315; **J. M. Mathes Inc.,** advertising, $11,290; **Loomis, Saffren & Fernald,** auditors, $11,969; **Skadden, Arps, Slate & Timbers,** legal services, $32,000.

North Central Airlines Inc.—H. N. Carr, president and director, $24,050 salary, $600 directors fee and 35,000 shares of common stock; **F. N. Boltomer,** vice president—traffic and sales, $12,820 salary, no fee and 5,000 shares of common stock; **A. E. Schwandt,** vice president—industrial relations, $10,300 salary, no fee and 5,000 shares of common stock; **B. H. Bendle,** vice president—maintenance & engineering, $11,820 salary, no fee and 5,000 shares of common stock; **A. F. Niemeyer,** vice president—operations, $12,360 salary, no fee and 5,000 shares of common stock; **B. Sweet,** secretary secretary-treasurer, $10,200 salary, no fee and 5,000 shares of common stock.

A. E. A. Mueller, chairman, board of directors, $21,042 salary, $600 directors fee and 498,820 shares of common stock; **W. L. Christensen,** director, no salary, $700 directors fee and 5,002½ shares of common stock; **G. F. DeCoursey,** director, $2,400 salary, $700 directors fee and 8,002½ shares of common stock; **K. B. Willett,** director, no salary, $700 directors fee and 11,000 shares of common stock; **A. L. Wheeler,** vice president, legal counsel, director, $12,125 salary, $700 directors fee and 1,000 shares of common stock; **B. F. Grover,** director, no salary, $700 directors' fee and 3,300 shares of common stock; **Fairchild, Foley & Sammond,** legal services, $5,180; **Klau-Van Pietersom-Dunlap Associates Inc.,** advertising services, $78,807; **Ray & Ray,** statistical information, $18,394.

Ozark Air Lines Inc.—L. D. Hamilton, president, $20,000 salary, $900 bonus and indirect compensation and 173,302 shares of common stock; **A. A. Blomeyer,** vice president, no salary, $300 bonus and indirect compensation and no stock; **A. G. Kryor,** secretary, $4,607 salary, $900 bonus and indirect compensation and 30,500 shares of common stock; **F. W. Jones,** treasurer, $7,200 salary, $900 bonus and indirect compensation and 150 class A common shares, 375,000 class B common shares and 350 general common shares, for a total of 375,500 shares; **O. L. Parks,** director, no salary, $900 bonus and indirect compensation and 2,000 shares of common stock; **E. W. Weaver,** director, no salary, $375 bonus and indirect compensation and no stock; **G. O. Shaver,** director and captain, $11,352 salary, $900 bonus and indirect compensation and 123,760 class A common shares and 950 class B common shares for a total of 124,710 shares; **C. A. Bachman,** director, no salary, $900 bonus and indirect compensation and 50 shares of common stock; **B. T. Mollingly,** chairman, board of directors (deceased 1957), $8,750 salary, $4,450 legal fees for 1957, and 9,300 class A common shares, 142,817 class B common (VT) shares and 164,177 shares; **Torney & Torney,** legal services, $6,100 and expense reimbursed, $706.

AIRLINE OBSERVER

▶ Economic recession, coupled with unfavorable weather and a poor Florida winter season hit the airlines hard in March. Load factor for the month averaged 58.6% for domestic trunklines, 2.14 points below that for March, 1957. It was the sixth consecutive month that load factors have held below 59%, the longest period since March, 1949, that load factors have been sustained at such a low figure. Passenger miles for the 12 months ended in March, 1958, increased 10.6%, the lowest percentage increase recorded over the preceding annual period since the year ended July, 1950. Coach traffic continued its climb. In March, 39.23% of all traffic was coach as compared with 37.22% in March last year and 35.54% in March, 1956.

▶ Watch for a reversal of an Australian federal government decision designed to prevent Ansett Airways from taking delivery of four Lockheed Electras on order (AW April 14, p. 43). Australian government previously had made an attempt to reject applications for the importation of the Electras and force the airline to purchase Vickers Viscounts. Strong protests by Ansett against the action, coupled with threats to take the case before the public, will likely result in a reversal of the government decision.

▶ Post Office Department has joined four schedule airlines in protesting recent requests for subsidy by Riddle Airlines and Slick Airways (AW April 7, p. 38). Post Office is claiming that subsidy for the two carriers is not in the public interest. In protesting Riddle's petition for subsidy, Eastern told the Civil Aeronautics Board that it has "so much unused airlift capacity for mail, it would be ridiculous to require new Puerto Rico-U. S. mail service."

▶ United Air Lines has taken exception to Civil Aeronautics Board Examiner's initial decision recommending that TWA's siesta sleeper seat configuration is approved. In its protests, United said the examiner had not determined a reasonable break-even load factor on which to establish a reasonable fare. United charged that because of the extra space needed for the configuration, amounting to 30% more space for each passenger, TWA should charge an extra $47 on each one-way transcontinental ticket.

▶ Air Force will release to Boeing and Pratt & Whitney most performance data compiled during the KC-135 jet tanker's 13 hour, 48 minute flight from Tokyo to the Azores (AW April 14, p. 37). Brig. Gen. William B. Eubank, flight commander on the flight, said the data will be of particular interest to airlines planning jet operations. He said takeoff roll of the tanker was 10,500 ft. with 31,000 gal. of fuel. Temperature at takeoff was 50 deg. Aircraft flew at 44,400 ft. at an average speed of 550 mph. Original flight plan to Madrid was canceled at the Azores because of the adverse jet stream which at times produced 135 kt. head winds.

▶ Civil Aeronautics Board is considering two measures designed to accumulate statistics on the operation of foreign air carriers to the U. S. in response to demands by U. S. airlines for more accurate traffic data in order to show the benefits foreign airlines are getting from bilateral agreements with the U. S. The Board has suggested that passenger tickets be photostated to develop true origin and destination of each passenger. Board also has asked the Bureau of Budget to change an Immigration and Naturalization Clearance form so that passengers would be required to report routing, true origin and destination.

▶ International Civil Aviation Organization has established basic principles to be applied by governments deciding to adopt user charges against airlines. Essentially, principles call for equal charges on carriers of all countries including the country imposing the charge. Charges should not be imposed for facilities not required nor should fees be established in such a way to discourage use of facilities essential to safety.

▶ Department of Defense and Civil Aeronautics Board staff members have concluded a five-day meeting in an attempt to settle controversial issues of maximum use of civil air carriers by the Department of Defense.

Airline Income and Expenses—January 1958

	Passenger Revenue	Mail Revenue (U. S.)	Express Revenue	Freight Revenue	Charter Revenue	Total Operating Revenue	Total Operating Expenses	Net Income (before tax)
DOMESTIC TRUNK								
American	$21,275,028	$546,059	$274,846	$1,413,203		$23,971,245	$23,087,476	$883,769
Braniff	4,622,219	120,921	51,297	121,981	$48,802	4,779,855	4,497,532	190,855
Capital	7,609,792	176,859	92,822	108,420	13,604	8,091,906	8,351,783	−259,857
Continental	1,758,244	40,842	17,765	37,405	300	1,909,241	2,087,489	−178,248
Delta	6,529,236	141,521	96,445	226,714		7,139,246	7,376,749	−339,934
Eastern	20,579,671	304,188	840,620†			21,842,165	20,568,430	1,234,688
National	5,171,246	95,287	18,386	140,857	32,076	5,650,567	5,415,327	157,053
Northeast	1,684,535	33,552	15,051	26,655		1,866,330	2,376,990	−617,503
Northwest	3,702,792	132,976	305,086†		2,218	4,187,981	4,958,329	−770,347
Trans World	14,847,000	352,000	190,000	421,000		16,449,000	18,226,000	−1,987,000
United	18,707,651	777,807	275,885	960,133		20,991,654	21,430,134	−438,480
Western	2,508,585	90,186	34,881	74,827	6,526	3,734,799	3,421,380	271,117
INTERNATIONAL								
American	453,012	3,496	111	61,480		540,841	518,788	22,057
Braniff	592,980	10,070		33,977		685,759	869,863	−22,906
Caribbean Atlantic	177,646	2,076	6,789†		510	198,799	167,376	23,534
Delta	557,932	4,770		9,217		601,429	808,874	96,316
Eastern	1,849,182	35,949	57,553†			1,924,671	1,547,591	73,639
National	406,503	3,683	1,690	12,699	14,875	450,528	343,829	104,008
Northwest	1,342,185	461,637	227,296†		5,923	2,121,744	2,040,635	81,108
Pan American								
Alaska	180,000	13,000		34,000		234,000	398,000	−108,000
Atlantic	5,410,000	609,000		735,000	386,000	7,761,000	9,512,000	−1,744,000
Latin America*								
Pacific	4,116,000	457,000		540,000	381,000	5,826,000	6,278,000	−452,000
Panagra	1,134,200	42,800		151,900	23,000	1,583,400	1,611,500	−25,800
Trans World	2,893,000	423,000		249,000		4,085,000	5,655,000	−1,455,000
United	861,446	32,656		18,423		920,524	914,250	13,908
Western	160,508	431		1,243		189,093	164,118	−3,196
LOCAL SERVICE								
Allegheny	366,985	8,075	4,144	8,237		801,325	749,443	−148,118
Bonanza	205,142	3,269	1,460	4,120	680	356,723	362,970	−6,003
Central	127,778	3,448	808	4,044	2,744	335,635	362,519	−27,871
Frontier	277,420	215,412	2,211	21,893	8,416	532,922	565,617	−34,215
Lake Central	140,290	3,893	5,102†		926	302,954	322,103	−20,021
Mohawk	371,901	4,152	5,354	9,389	5,880	587,024	756,753	−192,390
North Central	625,286	18,215	10,494			898,663	1,011,717	−117,326
Ozark	329,140	236,569	5,932	7,706	4,669	588,768	630,360	−46,700
Pacific*								
Piedmont*								
Southern	191,103	7,543	2,934	2,496	929	375,775	422,834	−47,880
Trans Texas	263,200	9,252	3,102	9,480	3,498	552,256	565,149	−12,881
West Coast	189,791	3,462	1,100	2,728	2,074	352,193	403,849	−51,333
HAWAIIAN								
Hawaiian	335,443	2,901		51,786		399,219	460,478	−68,876
Trans Pacific	141,692	688		6,926		160,518	188,057	−27,539
CARGO LINES								
Aerovias Sud Americana			116,832	19,431		139,826	152,769	−14,529
Flying Tiger		9,326	742,749†		1,419,334	2,138,373	2,382,983	−327,720
Riddle		5,950	363,720†		396,821	762,678	13,035,792	−191,442
Seaboard & Western*								
Slick*								
HELICOPTER LINES								
Chicago Helicopter	31,829	104,901				136,706	151,591	−20,390
Los Angeles Airways	13,462	9,809	5,721			108,623	98,222	11,528
New York Airways	41,697	3,884	1,317	2,414		191,239	193,338	−1,052
ALASKA LINES								
Alaska Airlines	106,496	36,366	714	33,834	58,257	420,980	440,548	−14,625
Alaska Coastal	40,358	9,193		6,276	915	85,839	116,146	−31,588
Cordova	4,503	35,428		3,352	4,839	48,969	62,081	−13,111
Ellis	...	...						
Pacific Northern	333,308	54,745	57,491†		2,931	700,081	741,932	−57,484

* Not available.
† Combined property figure.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

SHOOTING FOR THE MOON

The engineer shown here has just completed simulated high altitude tests on a new shielded insulation that comes a step closer to meeting the needs of space travel.

Down-to-earth laboratory research like this may seem like a rather indirect way of shooting for the moon, but it happens every day at the Auto-Lite Wire Laboratory at Port Huron, Michigan. Here every engineer knows that any trip to the moon must start in the laboratory. The Auto-Lite engineer is always thinking about ways and means of creating insulations that will make possible still greater advancements in aviation and electronics.

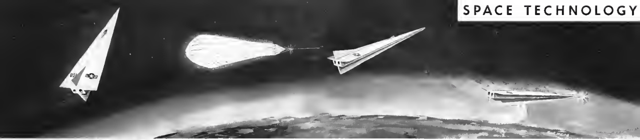
Hundreds of different wire insulation materials are being tested here by the finest trained personnel using the most modern research techniques and equipment. Out of these tests comes a wealth of knowledge important to all customers served by Auto-Lite.

No matter what you need—whether it be high temperature aircraft wire or cable, magnet wire or wire for electronic and electrical applications—why not tell us your insulation problem and let us help you.

AUTO-LITE®

Wire and Cable DIVISION

THE ELECTRIC AUTO-LITE COMPANY
Port Huron, Michigan • Hazleton, Pennsylvania



THREE possible phases of orbital flight in a hypersonic glider are shown in artist's conception. Orbital travel time, which would probably be critical for first manned vehicles, could be controlled to some extent by glider attitude (maximum drag position, left), retarding balloons (center) or electrical drag devices (not shown). More positive control could be effected through retro rockets, although they are a serious weight penalty. For some designs the most efficient use of rockets during vehicle re-entry could be to fire them downward (slightly exaggerated—right) during the critical heating period, which might last about five minutes. This would increase the glider's effective lift drag ratio, reduce its rate of descent into dense air and lower maximum skin temperatures.

Orbital Re-Entry Will Intensify Demands On Structures

By J. S. Butz, Jr.

Washington—Hypersonic speeds will bring changes in aircraft structures comparable to the advance from wood-fabric design to all-metal construction.

This paraphrase of a statement by Walter R. Dornberger, technical assistant to the president of Bell Aircraft Corp., illustrates the difficulties now encountered in designing the structure of a winged vehicle which can orbit the earth and return intact.

No other phase of hypersonic vehicle design relies more completely on untried techniques and materials. As a result, the feasibility of sustained flight above Mach 5 generally has been limited by the progress of structural and materials engineers in solving the high temperature problem.

Pacemaker's Role

In the past, the role of pacemaker usually has alternated between the aerodynamicist and the powerplant designer. Aircraft speed was restricted either by the drag and instability of the airframe or insufficient power. Rocket motors have essentially removed the limits on power and orbital velocity is now possible. Most authorities agree that the aerodynamic uncertainties at these speeds can be resolved in thin air.

Evidence that the required structural capability is also within reach was displayed last month when major aircraft companies submitted proposals in an Air Force competition for an orbital bomber, the Dyna-Soar. A contract award is expected before May 1.

Two main structural problems faced in these proposals are:

- **To keep rapid heating** experienced during re-entry from making the aircraft expand unevenly, warping it out of shape. Stresses induced by such uneven expansion reduce the structural strength available to carry air loads. Warping distorts lifting surfaces so that their air loads are altered, usually with a detrimental effect.
- **To keep structural equilibrium** temperatures low so that available materials will retain useful strength.

Exact structural solution undoubtedly varies with each separate design proposal, but the probable approaches have been well identified in the technical literature published in this country and abroad. National Advisory Committee for Aeronautics, service laboratories, private institutions under military contract, the U. S. aircraft industry and laboratories abroad such as the Royal Aeronautical Establishment all have contributed heavily to this research.

Using these findings as a basis, the methods of reducing and accepting high temperatures at hypersonic speeds are summarized under two general headings: one involves aerodynamics and the powerplant because they can have as much effect on the aircraft's final structural design as any type of cooling system, insulation or construction, and the second deals with new structural methods.

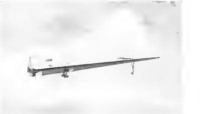
Elimination of aerodynamic heating can be accomplished to a great extent by regulating the flight program. Ideal flight program would enable a hypersonic glider to lose most of its velocity in the very thin air around 300,000 ft. Then, as it returned to denser air, the glider would be sufficiently slowed, so that heating would be negligible.

Means of Deceleration

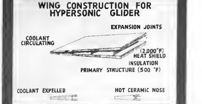
Two means are available to slow an aircraft while still allowing it to maintain altitude: power, or a combination of aerodynamic lift and drag. Unfortunately, neither of these means is efficient enough to allow the ideal flight program to be followed.

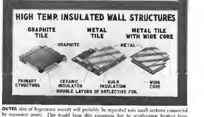
If aerodynamic lift could support the aircraft at 300,000 ft. while drag slowed it down, the wing would have to have an almost infinite lift drag ratio and the wing loading would have to be near zero. At present the lift/drag ratios for high speed wings reach 6 at best with an effective value to about 12 when centrifugal lift is considered.

If the vehicle was supported by power while its velocity was reduced by retro-rockets, the powerplant and fuel weight would have to be at least as large as the booster which propelled it in the first place. This would mean that the ve-



AERODYNAMIC requirements for a conventional landing are generally in conflict with those for minimum heating at high speed. Adequate control and loadings may necessitate jettisoning part of aircraft, using boundary layer control or variable geometry wings.





OUTER skin of hypersonic aircraft will probably be separated into small sections connected by expansion joints. This would keep skin expansion due to aerodynamic heating from warping aircraft out of shape. NACA suggestions above show how expansion joints and several materials, insulation, reflective foil and cooling systems might be used to lower temperature and thermal stresses of inner structure which would carry primary air loads.

hicle, plus booster at takeoff, would have a payload of at least 50% of total weight, which will probably be out of the question for many decades

Although the ideal is not presently attainable, it is foreseeable that fuel specific impulse and wing efficiency will be improved to the point that the second or third generation of hypersonic aircraft will overcome the heating problem by losing most of their speed at high altitudes

At present the critical heating period facing a vehicle re-entering from orbit lasts about 5 min Skin temperatures rise to 2,000F and maximum temperatures around the nose and wing roots go two or three times higher

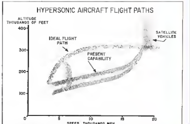
These temperature values depend on a number of design factors and the main design effort is to achieve the combination of these factors which will give the lowest temperatures heating rates and exposure times.

One of the compromises is that the aircraft needs a wing with a high lift/drag ratio so it will be an efficient glider and stay at altitude longer But to handle local heating the nose and wing leading edge need to be rounded This raises the drag and reduces the lift/drag ratio so that the aircraft's speed and temperatures are increased as it enters dense air. This also increases the time that the maximum heating lasts

Another compromise is that the vehicle needs a very light wing loading so aerodynamic lift and drag become effective at a very high altitude However, an addition to the wing area to achieve this increases wetted area and skin friction drag. Addition of cooling systems, insulation and any other means of combating the heat problem all add weight This raises the wing loading and the aircraft will have to lose more of its kinetic energy at lower altitudes In turn, this will aggravate the heating problem so the cooling weight requirement goes up again with another adverse effect on wing loading before a balance is reached

Need for landing the hypersonic glider in conventional fashion also has its effect on high altitude performance and the heating problem Wing efficiency at hypersonic speeds depends primarily on two factors span and the length of the wing measured fore and aft (e.g., in the plan view of a swept wing the distance between the leading edge of the root chord and the trailing edge of the tip chord measured along the centerline of the aircraft) An efficient wing with a long fore and aft dimension indicates a high sweep angle NACA also recommends about 65% of sweep to keep heating to a minimum However, at low speeds wing efficiency demands a long span and a short chord The arrow or sharply swept delta wings which are good at high speeds are poor for landing Thus reaction jet controls, boundary layer control, or a variable geometry configuration might have to be used for safety at low speed

It is possible that a structural or cooling system weight saving might be effected and a lighter, better performing vehicle produced through the judicious use of power as the hypersonic glider neared its critical heating period During the critical heating period maximum temperatures are



FLIGHT limitations of currently feasible hypersonic gliders are shown in the NACA estimate above The ideal flight path would only be attainable after great increases in available lift through better wing efficiency or fuel specific impulse Any upward shift of the corridor of present capability will lower skin temperatures and relieve the structural problem

reached very rapidly creating what is known as thermal shock

A downward firing rocket burning for three or four minutes and producing a few thousand pounds of thrust could improve the vehicle's effective lift/drag ratio from about 10 up to 13 or 14 and lessen the thermal shock At the same time the aircraft's weight would be dropping rapidly as the propellants were exhausted, again reducing heating

It also is possible that through this use of power the aircraft could lower its angle of attack and yet maintain the same effective lift/drag ratio This would lower the lift/drag ratio the vehicle was pulling aerodynamically and lessen the severity of the heating

If designers of air-breathing engines continue to improve the altitude performance of their products as they have in the past ramjets would be a much more efficient source of power for this purpose They would reduce the necessary fuel load or greatly increase the time that power would be available

Designing for Heat

Most important variable in the heat problem is time Heating rates and stagnation temperatures of many thousands of degrees can be withstood by known structures for the few seconds of intense heat that might occur during a ballistic vehicle's re-entry

Hypersonic gliders pose a completely different situation Most structural work for these vehicles has been to provide wings and bodies that will

NACA quartz lamp rig to simulate aerodynamic heating of wing Tests heat upper and lower surfaces unevenly to produce effect of flight at high lift/drag ratio

withstand skin temperatures to 2,000F and leading edge temperatures above 4,000F for several minutes. Exact temperatures, heating rates and times of exposure would vary with each vehicle.

One of the most widely discussed methods of controlling heat is to have a lightly loaded outer shell which gets very hot and keeps heat away from a heavy, relatively cool understructure which carries most of the air loads. Main problem with this thin outer skin is to find a material that can resist high temperatures and then to fabricate it in such a way that it may expand quickly and easily without buckling. This can be accomplished by separating the skin into small sections which are joined together by sliding and expansion joints, giving the structure a waffled or tiled appearance.

High temperatures on this waffle skin are kept away from the understructure by radiation cooling and insulation, in some cases discussed in the literature. Several strips of reflective foil return much of the heat to the skin. A layer of insulation material then greatly reduces the heat transfer rate to the understructure so that it will not reach its maximum temperature until after maximum air loads have passed.

Radiation Cooling

Radiation cooling is one of the most effective means of cooling the aircraft. About 40% of the heat transmitted to the outer skin by the boundary layer can be returned to the atmosphere by this method. Designers are attempting to improve the reflective qualities of the surface of operational aircraft.

Other cooling systems which have been suggested include pumping coolant through a double skin, transpiration cooling using a porous or holed outer skin so that coolant will seep out and cool the boundary layer, and forcing coolant out at the leading edge so that the after skin is covered with a thin film of liquid.

Covering the aircraft with a solid material which will reach a gaseous state at relatively low temperature also is considered promising. These ablation materials are usually organic and become gaseous around 800F. As the material boils away it keeps the structure underneath at this boiling temperature.

Most serious problems are to have the ablation material expand at the same rate as the skin it is bonded to so it won't crack off. Material also has to be relatively free of thermal stresses to keep its surface from cracking and spalling or breaking away. The slightest hole or flaw in the ablating surface usually leads to its complete disintegration.

Studies are being made to determine

the feasibility of cooling an aircraft by giving it an electrical charge which will repel a portion of the ionized air flowing about it above Mach 10. Another method would obtain useful thrust from the liquid used to cool a high speed structure. Coolant liquid would have a lower vaporization temperature than the equilibrium temperature of the outer skin. As the liquid was passed through ducts underneath the outer skin, it would vaporize and be expelled through nozzles in the aft portion of the fuselage and wings to provide thrust.

Heat Sink Method

The heat sink method of handling heat consists mainly of strengthening the structure to take bending loads due to uneven heating and expansion in addition to the usual air loads. However, the structural material has less strength because of its high temperature than it would if it were cooled. There are instances when this construction method would have a weight advantage over structures with elaborate cooling systems.

Most structural experts believe that practical aircraft will use combination of these construction and cooling methods.

A very serious problem which requires an answer no matter what type of construction is used is the proper design of high temperature joints. In a structure under transient heating, the joints help to transmit the heat and one end of the joint is at a higher temperature than the other. Heat through structional joints presently used is not even primarily distributed because of varying rivet and attachment pressures and the thickness of rivets, bolts and welds. This creates large thermal stresses which are being combated by using strips of good heat conductors laid between the overlapping sheets of metal to spread the heat more evenly. Another method uses two or more types of materials in joints so that differences in their thermal expansion will compensate for their differences in temperature.

Uncertainty surrounds the following problems: determining the stresses in heated joints, reduction in structural stiffness and increased tendency to flutter caused by heat, creeping and distortion of loaded structures with time at high temperatures, and the prediction of fatigue life. The safety factors which this lack of knowledge forces into the structural calculations will undoubtedly make the first hypersonic configuration heavier than ones which follow.

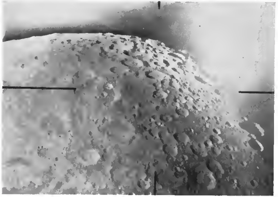
At present there is a need for test facilities which can subject large segments of full scale aircraft to simultaneous heating and airloads, preferably in dynamic form.

Some large facilities of this type are in various stages of construction at government laboratories.

Not Heavy

Even though the first hypersonic re-entry from orbit gliders may have structural safety factors which later prove to be unnecessary, the vehicles probably will not be heavily constructed in comparison to current supersonic combat aircraft.

The gliders will fly so high to keep heating within bounds that their maximum dynamic pressures and air loads may never be greater than those experienced at sea level at 400 mph. Gliders also will fly in essentially straight lines with maneuvers sharply restricted to keep air loads low.



Tracker's Moon Photo Shows Craters

Moon surface, photographed with Recording Optical Tracking Instrument Mark II, is magnified to appear as it would from a distance of 250 mi. ROTI II, developed by Perkin-Elmer Corp. to track Atlas intercontinental ballistic missile flights, is installed at Patrick AFB, Fla. (AW Oct. 28, p. 110)

Reorganization Plan Responsibility Not Clarified for Defense Personnel

New York—Proposal for reorganization of the Defense Department has created some confusion among Defense personnel as to which group is responsible for specific missile and space projects, William M. Holaday said at a recent Society of Automotive Engineers National Aeronautic Meeting.

Actually, said the Defense Department director of guided missiles, this confusion is not as bad as it first seems. The Advanced Research Projects Agency has been assigned specific projects and further assignments to this group are currently under consideration. The question of who will get responsibility for the development of a million-pound-thrust rocket engine is now being worked out by Holaday, ARPA Director Roy W. Johnson and Deputy Defense Secretary Donald A. Quarles.

At a press conference following his luncheon talk, Holaday also gave the reasons behind last summer's cutback in the Martin Titan intercontinental ballistic missile project. It was, he said, simply a matter of reorientation to put the various phases of the program back in balance—routine in the business.

Development had raced ahead faster along certain lines than in others. For one thing, it looked as though the missile was going to be ready before the bases needed to fire them were operational.

It was not a case of cutting back priorities or falling behind in development because of lack of money. "You cannot buy thinking with money," he declared.

There is no plan to phase the Titan out, he said. It will definitely go into production. At this point, however, it is still in the early research and development phase. So far, only one of the engines has even been static fired.

Referring to the subject of rocket propellants, Holaday said that the current liquid combinations, particularly kerosene and oxygen, had just about reached their limit. The need now is for propellants with higher specific impulses and smaller logistics problems.

Both solids and storable liquids can help meet this need. One of the older fuels, red fuming nitric acid, was used by Holaday, an experienced propellant man, as an example of a storable liquid, provided some material can be found to store it in.

Aircraft Skin Alloy

Ryan Aeronautical won first prize at National Design Engineering Show in Chicago with Mini-Wate, an outer skin alloy for high speed aircraft.

Asked what progress was being made in the stabilization of liquid hydrogen, Holaday replied that little had been accomplished commercially. Referring to liquid hydrogen as a high energy fuel he declined to say where it now stood as far as military development was concerned. (Liquid hydrogen is called SF-1

—Special Fuel 1—by some members of the industry)

On the matter of the workload at Cape Canaveral Holaday said that there was still room for more testing but there was little question that other facilities would be needed as the number of missiles under development continues to grow

Equipment and safety facilities are being put into Camp Cooke in order to build that up as a Pacific test site (AW March 17, p 21)

Unlike Cape Canaveral, the West Coast range will not be a research and development facility to its full extent One reason is the high cost of clearing a large area of the Pacific for range safety prior to a test

In reply to a question as to the wisdom of putting money into development of an anti ICBM weapon that is reported to be only 25% effective Holaday pointed out that nobody could possibly know just how effective the Nike-Zeus will be until some hardware is developed that actually can be tested Some people in the program he said believe that it will get not only one-out-of-one enemy missiles but 10-out of 10 or, in other words, one right after the other

Work on new anti submarine weapons is progressing There is a great need for such devices, Holaday said Without going into details, he added that the newest weapons operate at quite a depth and are much more effective than the old torpedoes

Solids vs. Liquids

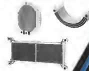
Between 1958 and 1970 liquid propellant rocket engines may be best suited for specialized missile applications requiring high performance or extremely large load-carrying ability, for satellite propulsion systems and for space flight systems

This was the conclusion reached by George S Sutherland of Boeing Airplane Co who made a point-by-point comparison of solid and liquid rocket propellants

Comparison was based on large conventional chemical rocket engines (defined as weighing more than three tons including hardware and propellants) and was concerned more with future application and capabilities than past performances

Among the criteria weighed in his counterpoised listing were the following

- Specific impulse—Solids may reach 260 by 1965 but are not likely to reach the 313 attainable with a liquid fluorine hydrazine system Because of high cost and handling difficulties, however, the liquid fluorine system will be used only for special high performance applications
- Propellant loading fraction—Liquids



have and will maintain a slight edge.

- **Storage time**—Solids have a definite advantage here.
- **Thrust vector control**—Gimbaling arrangement in liquids is superior to the jet vanes and jetevators used with solids. The use of a movable exhaust nozzle with solids is attractive and may be possible if an effective joint seal can be developed.
- **Thrust termination**—Closing propellant valves in liquids is simple and effective. Blowing off exhaust nozzle in solids will not work with some propellants and may result in large longitudinal accelerations. Opening of forward facing exhaust ports is another scheme for solids, but it is still too early to say how well it works. A third method depends upon the discovery of some extinguisher that could be injected into the motor in small quantities.
- **Thrust level control**—In liquids, throttling has proven flexible and effective and can be carried out on command. Grain design in solids is effective for pre-selected burning levels but cannot be varied after the engine is fired.
- **Combustion instability**—This has been more of a problem for liquids but is diminishing with the accumulation of experience.
- **Thrust duration**—Regenerative cooling gives liquids almost unlimited duration (as long as there is propellant). It is unlikely that solids will ever be able to match this.
- **Temperature sensitivity** — Burning rates of solids increase as much as 0.2% per deg. F increase in initial temperature. Solids are under development which will not have this problem.
- **Simplicity and reliability**—Liquid rocket engines with their much larger number of working parts many of which are arranged in series, have poorer reliability and require more sophisticated pre-flight inspection, fueling and checkout equipment. The outstanding problem in checking out solid engines today is the need for an efficient crack detector.
- **Costs**—It costs about five times as much to develop a liquid propellant rocket engine as it does to develop a comparable solid unit, but no more to produce it.

Solid propellant rocket engines will continue to go into the small missiles and into auxiliary applications such as vernier engines and retro-rockets. In addition, they will find a market as a main powerplant in intermediate range and intercontinental ballistic missiles.

For a terrestrial vehicle like the ICBM, Sutherland said, the advantages of simplicity and improved logistics make the solid propellant rocket engine a logical choice. At the same time, for applications demanding higher burnout

velocities, the extra performance potential of the liquid rocket becomes extremely important.

Among other things, it permits a reduction in the number of stages required as well as in the overall bulk of the vehicle.

There is little question that sustained thrust generation will be a requisite to extended space flight.

The question, rather, is what kind of powerplant can be developed to meet this requirement.

One possibility is the ion propellant rocket engine. During 1957, the Directorate of Advanced Studies, Air Force Office of Scientific Research sponsored a theoretical investigation of the ion engine at Rocketdyne Division of North American Aviation, Inc. The results of this program, according to Rocketdyne's Robert H. Boden, indicates that an ion rocket engine in which the propelling ions are accelerated by an electrostatic field is capable of producing usable thrust levels and will be utilized to supplement various other types of rocket engines in applications to space vehicles.

There are a number of technical problems yet to be solved, of course, before the first ion rocket engine becomes a working reality. The most formidable of these have to do with the development of the ion generator propellants and a high specific power generator.

The Directorate of Advanced Studies plans to continue sponsorship of the ion propulsion research program during 1958.

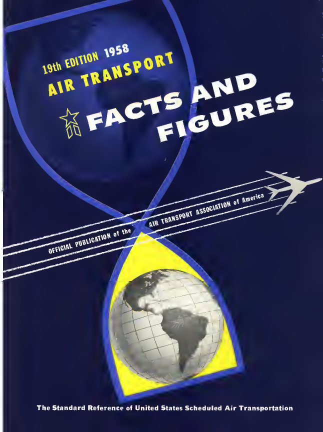
And sometime during the current year, according to Boden, Rocketdyne will begin a limited experimental program in hopes of verifying some of the data already gathered.

The prospects of another futuristic fuel system, free radicals, also appear dim.

When all things—such as motor and storage tank design—are taken into account, said Y. C. Lee and S. T. Demetriades of Aerojet-General Corp., the problems presented by free radicals preclude their successful use as propellants at this time.

As an example of what they meant, Lee and Demetriades took the case of a free radical propellant that starts out with a specific impulse of 1,200. By the time the free radicals are incorporated in a practical solid propellant system, the final specific impulse will have dropped to 600.

They said as much as 50% of the available energy may go into the ionization and dissociation of reaction products instead of into useful kinetic energy due to the high combustion temperatures (10,000K) associated with free radicals.


19th EDITION 1958
AIR TRANSPORT
FACTS AND FIGURES
OFFICIAL PUBLICATION of the AIR TRANSPORT ASSOCIATION of America
The Standard Reference of United States Scheduled Air Transportation

THE FIRST TWENTY YEARS

This year's report on the status of the scheduled airlines is both a record of the year just past, and a summing up of two decades of progress.

Because it looks to the past, it can also be called a history. The airline industry, however, has never had time to look into the past. The face of the industry from the very beginning has been firmly fixed to the future.

And what a future lies ahead!

With the inauguration of jet airline service expected late in 1958, the airlines find themselves today at the dawn of an age that will make all previous growth seem almost insignificant by comparison.

It has been the custom of late to refer to the introduction of these new planes as the "Jet Revolution." This is not an apt phrase because the advent of the jets will not come all at once to find the industry unprepared.

Rather, it will be the logical climax to a series of studies that began years ago, long before the first commercial jet prototype took to the air.

The equipment has been studied, and restudied, for a total of hundreds of thousands of man hours. This enormous amount of research has been carried out by the airlines, acting individually and in close co-operation with each other. Not only has the plane itself, and the power plants, been placed under the most detailed scrutiny, the airlines have also examined all of the supporting facilities that will be needed when the planes go into regular service.

Working in close partnership with the military, the airlines have received great assistance due to the wealth of experience that the Air Force has accumulated in jet operations.

The great expansion that lies ahead will provide many benefits for all of the segments of the airline public: the passenger, the shipper, and the postal user.

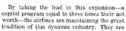
But more than that, the greatly increased airlift capability that will be made available with the new equipment will form a strong link in the nation's defense. More and more, military strategists point out, civil air power is becoming an inseparable adjunct to the concept of total air power.

Twenty years ago, a brief time by historians' reckonings, the rules of our industry were set out in the Civil Aeronautics Act. The Act also embraced, in addition to the rules, a philosophy that is even more meaningful today than it was in 1938. It called for the "encouragement and development of an air transportation system properly adapted to the present and future needs of the foreign and domestic commerce of the United States, of the postal service and of the national defense."

This was an unusual mandate to give a regulatory agency. The ever growing public usefulness of the air transport industry since that time, however, has demonstrated the wisdom of the Act's authors many times over.

By taking the lead in this expansion—a capital program equal to three times their net worth—the airlines are maintaining the great tradition of this dynamic industry. They are carrying out the national policy so clearly set forth by the Congress. Government now must do its part. The real character of the airlines' dramatic advance in technology must be recognized as must the national interest in their success. The wisdom of measures affecting the airlines should be judged against this standard. Facts and Figures for future years will show whether this has been done.

The first twenty years have now been completed. We look forward to the next twenty years, certain that they will contribute an even prouder chapter to aviation history.



Definition of Terms

Passenger Miles and Ton Miles

AVAILABLE SEAT MILES FLOWN Total seat miles available for sale in scheduled service

AVAILABLE TON MILES Total ton miles of lift capacity available for sale in scheduled and charter service

CHARTER FLIGHT Transportation of passengers or property on other than scheduled and designated extra section flights

EXPRESS TON MILE A ton of express flown one mile

FREIGHT TON MILE A ton of freight flown one mile

PASSENGER MILE One passenger flown one mile

PASSENGER LOAD FACTOR. The percentage of available seat miles actually sold in scheduled service

PASSENGER TON MILES Passenger miles converted to ton miles (See definition of revenue ton miles.)

REVENUE PASSENGER MILES The number of fare paying passengers flown times the length of trip in miles This is the amount of available seat miles sold

REVENUE PLANE MILES Aircraft miles flown in scheduled service

REVENUE TON MILES The ton miles sold in scheduled and charter service In the construction of this traffic measure passenger miles are converted to ton miles on the basis of about 10 to 1 That is ten passengers with allowable free baggage are accepted as equalling one ton

SEAT MILE One passenger seat filled or unfilled flown one mile

TON MILE LOAD FACTOR Percentage of available ton miles sold in scheduled and charter service

U S MAIL TON MILE A ton of mail flown one mile The mail figures are in two categories These are defined as Priority and Non-Priority Priority mail includes air mail and air parcel post Non-priority mail is first class mail that moves in air service At present non priority mail is being flown on an experimental basis between certain selected cities

Revenues and Profit and Loss

EXPRESS REVENUE. Revenues accrued from the carriage of express

FREIGHT REVENUE. Revenues accrued from the carriage of freight

INCOME TAXES Federal income taxes

NET OPERATING INCOME The total operating revenue from air transportation services less the operating expenses (see definition of Operating Expenses) Net Operating Income is before taxes and interest charges and does not include non-operating items

NET PROFIT OR LOSS Net income after Federal income taxes—the amount available for dividends or investment in the business This figure is subject to change because of the later adjustment of some accounting transactions and through revision of mail rates and subsidy by regulatory action

OPERATING EXPENSES The expenses incurred in the conduct of the business except for such items as debt financing and other non operating items.

RATE OF RETURN ON INVESTMENT Total return i.e. net profit plus interest paid on long term debt as percent of average investment Investment is the average of total net worth (stockholders equity) plus long term debt at the beginning and end of the year

PROFIT MARGIN ON SALES Net profit after interest and after taxes as per cent of operating revenues

OTHER REVENUE All other revenues including excess baggage, chartered services, foreign mails penalties for failure to cancel reservations service charges on non-revenue transportation of employees and special services such as photography and crop dusting

PASSENGER REVENUES Passenger revenues from scheduled operations

PUBLIC SERVICE REVENUES Payments by the Federal Government to insure air service to communities in the United States and its territories which could not otherwise afford it to maintain essential international air routes which are not yet self-supporting, and to develop helicopter service

U S MAIL REVENUE Service revenue for the transportation of mail This is the amount paid by the Post Office to purchase air transportation for mail and is not subsidy

Air Transport

FACTS AND FIGURES

19th Edition, 1958

The year 1958 marks the 20th Anniversary of U S scheduled air transportation under the Civil Aeronautics Act To show the vast growth of the industry in these two decades, the tables in this issue of Facts and Figures show the first year under the Act, 1938, then the post war years of 1946, 1948, and 1950, and then six consecutive years through 1957 Revised data filed by the scheduled air carriers with the Civil Aeronautics Board and the records of the Interstate Commerce Commission served as the major sources of the statistics

WHAT THE INDUSTRY DID IN 1957

The scheduled airlines set new traffic highs in 1957. They carried more people, and more property, more places and for longer distances than ever before.

1957 was a year in which the airlines flew:

- 49,339,000 passengers,
- 31,243,100,000 revenue passenger miles,
- 160,689,000 ton miles of U. S. mail, and
- 507,678,000 ton miles of freight.

Operating revenues were also at all-time highs. But operating expenses were up at an even higher rate, cutting sharply into the overall net profits of the industry. When the year was over, the airlines found that they had:

- Taken in $2,116,380,000 in operating revenues,
- Spent $2,051,339,000 for operating expenses, and
- Kept $42,477,000 as net profit after taxes and interest

Air Transportation—Still a Bargain Buy

In spite of the relentless upward trend of prices over the last twenty years, the airlines have held the fares to 1938 levels. In that year, for example, the average revenue per passenger mile for the domestic trunklines was 5.32 cents. For twenty years it hovered about that figure until today, including the recently authorized increase of 4 per cent with a $1.00 service charge per ticket, the average passenger revenue is only 5.42 cents based on carrier estimates for 1958, a gain of 1.9 per cent over 1938.

While air fares have gone up only slightly, service has improved markedly. Flying time between many cities has been cut in half, there is a greater selection of flights, cabin and meal service has improved, and planes are more comfortable, more dependable, and safer

Decreasing Dependence on Government Aid

Over the last two decades, the scheduled airlines have continually progressed toward self-sufficiency.

20 YEARS OF EVER-INCREASING SERVICE

All classes of Certified Air Carriers	1938	1957	percent increase
Number of Airlines	23	53	130
Cities Served[1]	286	706	147
Airplanes in Service	345	1 829	430
Seats Available (Daily)	4 800	94 200	1,863
Cruising Speed of Fastest Transport	220	360	64
Number of Passengers Carried	1 306 000	49 619 000	3 699
Number of People Employed	13 300	138 000[2]	938
Total Airline Payrolls	$27,396 000	$706 000 000[3]	2 477
Air Mail Ton Miles	7 449 000	160 664 000	2 057
Average Fare[4]	5 32	5 25	—1 3

[1] These figures include international cities as well as domestic points and 10 Hawaiian cities. In addition 241 Alaskan points were served in 1957 and 12 in 1938, making a total of 947 cities in 1957 compared to 298 in 1938.
[2] Data for year 1956.
[3] 12 months ending June 30, 1957.
[4] Average fare in cents per passenger mile.

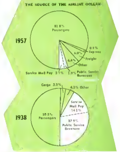
In 1938, the airlines received 42.1 per cent of their revenue from the government in the form of mail pay, which included both subsidy and payment for carrying the mail

Today, the payments have been separated into service mail pay and public service revenues. Although the airlines have carried increasingly larger amounts of mail, by 1957 their dependency on this revenue had been reduced to the point where only 3.1 per cent of airline revenues came from mail service.

Subsidy also continues to play a lessening role in airline income In 1957, only 1.9 per cent of the airlines' total revenues came from the government through these public service revenues.

The last of the domestic trunk lines went off subsidy during 1957. Today, the local service airlines receive the majority of public service revenues, a guarantee that smaller communities will receive the benefits of air transport service

The other public service revenues are used for the development of helicopter service and for the development and maintenance of national interest routes in Alaska, Hawaii and Latin America

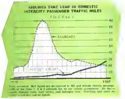


Airlines Now No. 1 Common Carrier

During 1957, the air transport industry took over first place among the common carriers competing for intercity passenger traffic.

Since the mid-1800's when the railroads first assumed the leadership from the barge lines and stage coaches, the Iron Horse had been the leader.

For the year, the airlines flew more than 25 billion passenger miles while the railroads operated approximately 21 billion. The buses, during the period, operated about 16 billion passenger miles.



Airlines Safety Record Outstanding

In 1957, the combined U. S. scheduled domestic and international airlines achieved a safety record almost unparalleled in airline history.

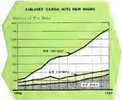
Today, it is more than four times as safe to travel by domestic scheduled airline than by automobile. During 1956, the latest period available, there were 26,100 auto and taxi passenger fatalities, a rate of 2.7 fatalities per 100 million passenger miles.

The airline rate was two-tenths of a passenger fatality per 100 million passenger miles in 1957, as compared with five-tenths of a fatality per 100 million passenger miles in 1956. This record was made during a year when scheduled carriers flew an all-time high of more than 31 billion passenger miles.

Cargo Business At New Peaks

Last year, the air cargo business leaped to new highs with the operation of more than 714,437,000 ton miles of U. S. mail, express and freight, an 8.83 per cent gain over 1956.

The scheduled airlines also achieved new levels of revenues from their cargo business



Where $191 million came from the flying of cargo in 1956, more than $209,211,000 in revenues were realized in 1957, a gain of 9.5 per cent.

U. S. mail ton miles were up 5.38 per cent, freight was up 12.49 per cent, but air express was down 12.57 per cent, due in part to a strike of Railway Express personnel in seven major cities from April to July.

Domestically, air freight rates have become in many cases, comparable with, and in some cases, lower than, the fastest surface transportation rate.

No Show Problem Reduced

With the co-operation of the public, the domestic airlines' program to reduce the number of no shows made notable gains during the year.

The airlines' three-point program was completed last September when a $3 penalty was initiated. Previously, the industry had instituted a ticket pick-up time-limit provision and a reconfirmation rule.

Surveys conducted during two one-week periods showed that only about one half of one per cent of the industry's passengers were assessed the no show penalty.

The survey also indicated that the number of no shows has been reduced from 14 per cent of passengers boarded to about six per cent.

DOMESTIC TRUNKLINES

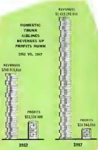
Public service revenues—commonly referred to as subsidy—dropped to zero for the domestic trunkline operations by the end of the year.

At the same time, it was a year when trunkline commitments to purchase pure jet and prop-jet aircraft and related ground equipment reached a figure of about $2 billion, representing a capital investment of approximately three times the value of present flight property.

As the domestic trunklines geared for the jet age during 1957, traffic continued to rise in all categories except one.

Revenue passenger miles showed an increase of 13.2 per cent, climbing from 21,643,141,000 in 1956 to 24,499,510,000 in 1957. This increase is a slight improvement over the previous year's gain of 12.6 per cent. The trunklines accounted for 78 per cent of the scheduled airline industry's total passenger mileage in 1957.

Mail volume rose 6.0 per cent to 97,194,000 ton-miles. Air express showed a drop of 14.0 per cent to 42,752,000 ton miles—attributable primarily to the Railway Express Agency strike.



Meanwhile, air freight volume totaled 218,432,000 ton miles for the year, representing a sharp increase of 14.6 per cent compared to the 9.5 per cent gain recorded in the previous year.

Although the trunklines handled a record volume of passenger and cargo business in 1957, earnings were seriously pinched by a mounting expense level that jumped 18.6 per cent from 1956. Net profit for the industry tumbled from $57.7 million for 1956 to $26.5 million in 1957—a drop of 54 per cent.

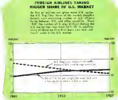
INTERNATIONAL AIRLINES

There is a critical need for improving our ties with peoples from all parts of the world. In this age of advanced technology the world has become smaller and countries find themselves next door to one another. It thus becomes essential that the people of the world come to understand one another in order to maintain or develop the status of friendly neighbors.

The best way to understand one another is to know one another. Toward this end, U. S. international airlines have made much progress over the years in helping to remove international travel barriers. Customs, immigration and public health facilities have been streamlined in the interest of quick entry into the United States of returning citizens and foreign visitors. The United States now compares favorably with respect to border-crossing formalities with most of the nations of the world.

These efforts are reflected in the increasing volume of international airline traffic. During 1957, U. S. international carriers flew 5,751,669,000 revenue passenger miles, as compared with 5,113,212,000 during the previous year. Cargo ton miles reached a new high of 123,280,000—an increase of 12.9 per cent over 1956, while mail ton miles jumped from 55,156,000 in 1956 to 57,265,000 ton miles in 1957.

The year was marked, however, by the unjustified grant of valuable air routes to foreign flag competitors—KLM and QANTAS—without exacting in return rights for U.S.-flag airlines of comparable economic value. These grants were contrary to the spirit of the United States' bi-partisan air transport policy.



LOCAL SERVICE AIRLINES

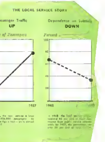
The local service airline industry rounded out its twelfth full year of operations in 1957 by carrying 3,949,000 revenue passengers, for a 12-year total of 20,305,000.

Created directly after World War II to link the intermediate cities of the nation with one another and with metropolitan centers, the local airline industry carried only 25,000 passengers in 1946, first full year of service.

Pursuing a program of constantly increasing public usefulness, the 13 local service carriers today operate a fleet of 225 transports over a system that measures 24,425 unduplicated route miles and reaches into all but four of the 48 states.

It is particularly significant that more than one half of all the cities served by the local airlines would have no direct scheduled airline passenger, mail or cargo service if it were not for the local carriers.

In the past 10 years the local airline industry has increased its passenger load factor from 27 per cent to 45 per cent and has increased passenger revenues ten-fold and total operating revenues five-fold. Accordingly, the percentage of public service revenues has declined—from 66 per cent of the industry's total income down to 36 per cent. Since 1952 the industry has increased its traffic over 100 per cent.



In 1957 Congress passed two bills designed to encourage airlines to re-equip. One guarantees loans that the local airlines and certain other carriers may secure for purchase of improved flight equipment and the other makes certain equipment trust provisions applicable to aircraft and aircraft equipment. Also, a bill was proposed which would permit local service carriers to apply the capital gains from the sale of obsolete aircraft to the purchase of more modern planes instead of having the proceeds deducted from their public service revenues.

HELICOPTER CARRIERS

One-hundred and forty-five per cent more passengers flew scheduled helicopter in 1957 than in 1956, testifying to the growing popularity and usefulness of scheduled helicopter service.

Serving greater Los Angeles, Chicago and New York, the helicopter airways carried 152,000 revenue passengers in 1957, compared to only 62,000 in 1956. Revenue passenger-miles totaled 3,273,000 in 1957, an increase of 106 per cent.

Largely through the introduction of additional and larger rotorcraft during the year, the helicopter airlines provided, in terms of seat-miles available, 126 per [illegible] than in 1956.

Air freight tonnage spiraled in 1957—a gain of 100 per cent to 11,000 ton miles. Air express tonnage increased at a faster rate than during the preceding year: 35,000 ton miles in 1957 for an increase of 13 per cent. The helicopter airlines flew 91,000 ton miles of mail, a gain of two per cent.

The three helicopter lines altogether operate 26 aircraft over 545 route miles serving 24 certificated points.

THE ALASKAN CARRIERS

In 1957 permanent certification for carriers operating between points in the United States and Alaska was authorized, permitting these airlines the same permanent operating rights that were authorized in 1956 for carriers operating within Alaska.

During 1957 the Alaskan carriers improved their scheduled traffic figures in the movement of passengers and mail, but showed a drop in cargo.

Revenue passenger miles went up 10.9 per cent to a 1957 figure of 151,886,000. U. S. mail ton miles went up from 2,383,000 to 2,702,000, a gain of 13.4 per cent. Cargo ton miles dropped 9.3 per cent with a haul of 7,208,000 compared to 1956 when 7,948,000 ton miles were flown.

Revenue ton miles showed a drop of 26.6 per cent with a 1957 total of 32,900,000 compared to 44,800,000 the year before. The fall-off was due largely to a reduction in the number of military charters, more than offsetting the gains in scheduled service.

TERRITORIAL CARRIERS

Last year the territorial lines achieved a gain in revenue passenger miles of 6.7 per cent over 1956 with 89,500,000 as compared to 83,900,000. U. S. mail ton miles increased slightly from 65,000 to 66,000.

In the freight-carrying field, the territorial lines increased ton-mile carriage from 1,475,000 in 1956 to 1,536,000 last year—a gain of 4.1 per cent.

Overall, the revenue ton miles of the territorial carriers went up 5.5 per cent, from 8,503,000 to 8,968,000.

THE ALL-CARGO LINES

The all-cargo airlines registered impressive gains in all categories last year. Their overall ton-mile haul was up 35.4 per cent over 1956, rising from 248,781,000 to 336,862,000.

Most spectacular increase was in air express which increased 29.4 per cent—from 1,266,000 ton miles in 1956 to 1,638,000 in 1957.

U. S. mail ton miles increased from 1,569,000 to 1,849,000—up 17.8 per cent while freight ton miles went up 10.5 per cent—from 140,420,000 to 155,126,000.

IMPROVING SERVICE TO POSTAL USERS

The year 1958 will see three anniversaries marked—all significant milestones in the history of air mail service and the story of its growth and usefulness to the postal service and the public.

They are: The 40th Anniversary of Air Mail, the 20th Anniversary of the Civil Aeronautics Act, and the 10th Anniversary of Air Parcel Post.

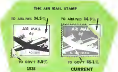
Air mail came into being on May 15, 1918 when World War I Army pilots flew mail between Washington, Philadelphia and New York. During that first year of air mail operations about 96 tons of mail were carried to produce $159,700 in "aeroplane" postage revenue. Today, air mail produces some $180 million annually in revenue for the Post Office Department.

On June 23, 1938 the Civil Aeronautics Act was passed which placed an obligation on the scheduled airlines to serve the postal system of the United States. Since then, public use of air mail has increased more than a thousand fold.

At least two other additions to mail movements by air have added to the usefulness and versatility of air mail. On September 1, 1948, parcel post gained wings and in September of 1953 the Post Office began what is known as the "Three-Cent Air Mail Experiment" under which domestic airlines carry first-class letters daily between certain cities on a space available basis.

When the airlines first began to carry the mail and fulfill their obligations under the Civil Aeronautics Act, public service revenues were an important source of income for the young industry. In 1938, 94.5 per cent of stamp revenues went to the airlines while the Post Office kept 5.5 per cent. Today, airlines receive only about 15 per cent and the remainder goes to the Post Office. "We save money every time we use air," the Postmaster General said recently.

Increasing usefulness of air mail is reflected in air transport industry figures for 1957. A total of 143,794,000 ton miles of letters, cards and parcel post shipments were flown—an increase of 4.9 per cent over 1956. Parcel post—lusty young



member of the air mail family, is growing steadily. Air parcel post shipments increased by 83.6 per cent over a six year period.

Three-cent mail carried by air increased, too. During 1957 this mail totaled 16,895,000 ton miles, up over 1956 by 9.53 per cent. This service benefits the public by making mail deliveries possible 12 to 48 hours sooner than if it had moved by surface, and a Post Office spokesman has said that studies of the experiment showed "that costs were not greater, in fact, they were running a bit less than when we were using surface transportation."

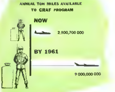
NATIONAL DEFENSE

While the airlines are dedicated to the public service, to the nation's commerce and postal service, they are dedicated also to the national defense.

As part of defense planning, the airlines—in cooperation with the Department of Defense and other government agencies—have established the Civil Reserve Air Fleet (CRAF) and

the War Air Service Pattern (WASP) for maximum domestic and global military airlift in time of national emergency.

The CRAF—composed of 368 long-range four-engine airliners, including 314 from the scheduled airline fleets—would operate on a global basis, carrying troops, supplies and equipment in support of the military effort. All remaining four- and twin-engine aircraft in the civil fleets would make up the WASP to provide an intensive system of priority airlift in support of defense production at home.



The machinery has been set up whereby the airlines can swing all or part of their operation into military service immediately should an emergency arise and be fully operational within 48 hours.

The advent of the jet age promises even greater benefits to the national security. Most of the turbine-powered aircraft on order are the types most desirable for wartime military support operations. When delivered, the civil capability under wartime conditions will be more than 9 billion ton miles annually, compared to the 2.8 billion of the present piston CRAF. The airlift capacity will be nearly 15 times more than the average annual airlift provided by the airlines during World War II in military and civilian service.

During 1957, the Air Force emphasized that it will depend upon the scheduled airlines for normal jet air transport lift in time of emergency. Secretary of the Air Force James H. Douglas said: "We have not ordered any turbo-jet transport aircraft for the Military Air Transport Service such as the airlines have on order in large number and which we count on the airlines making a part of the Civil Reserve Air Fleet."

In an unusual move, the Defense Department intervened in the General Passenger Fare Investigation hearings last year. The Department stated that "it recognizes as a matter of the greatest urgency the necessity for maintaining a strong, modern and economically sound air carrier industry to meet the requirements of national defense during peace time and national emergencies."

The airline defense role represents substantial saving to the American taxpayers. It would cost the government an estimated $550 million initially just to acquire the present piston CRAF, plus $350 million annually to maintain its readiness. Since most of the aircraft on order will be suitable for military airlift, most of the $2.5 billion investment being made by the airlines constitutes further substantial saving to the taxpayers.

Airlines as Military Partners

This unique capability of the airlines stands out as one of America's finest examples of military-industry partnership—a close, working relationship that serves the nation in peacetime as well as in time of emergency.

Every hour of every day the scheduled airlines serve the Department of Defense through the Military Bureau of the Air Transport Association and its field offices. To better serve the various branches of the armed forces, the scheduled airlines have established Joint Airline Military Traffic Offices (JAMTO's) at 68 military installations throughout the country. Under the jurisdiction of local military committees of the industry, these JAMTO's assist in making arrangements for movement of both cargo and personnel.

It is estimated that some 22 million man hours were saved during fiscal 1957 by the use of scheduled air transportation.

AIR NAVIGATION AND TRAFFIC CONTROL

One of the pressing needs for the orderly growth of civil aviation is a modern navigation and traffic control system. Such a system does not now exist but the government is encouraging its development.

A positive step toward this end was taken in May when the Special Assistant to the President for Aviation Facilities Planning, General Edward P. Curtis, made his report.

The report called for the setting up of the Airways Modernization Board, an independent agency "responsible for developing and consolidating the requirements for future systems which are needed to provide the necessary communications, navigational aids, and control needed to accommodate the future air traffic in the United States. It would be responsible as well for the systems engineering, the evaluation, and the selection of such aids as will best serve the needs of aviation."

It is clear that a revamped system will require considerable expenditure. The scheduled airline industry believes that the principle of payments for the use of such federally furnished facilities within the U. S. is a sound one. The airlines have been paying a fair share of the cost and they expect to do so in the future.

Increase in Fuel Tax Proposed

Any allocation of costs that is made, however, must take into consideration the degree to which the airways are used by the three components of aviation: military, air transport, and private and business flying. At year's end, the air transport industry was operating 1,829 planes, the military 40,000 and private and business interests, 60,000 planes.

Before assessing a higher fuel tax, as the government recently proposed, there should be a thorough study which will determine the actual use of the airways. According to the Administrator of the Civil Aeronautics Administration, the military makes use of the airways system 45 per cent of the time. Since the military also has an overriding, and understandable, priority call on the exclusive use of the airways, this fact should also be taken into account.

The vanishing air space remained a critical problem at year's end. As the Curtis report pointed out, "The American airspace is a natural resource that is on the verge of exhaustion in terms of the capacity of the system now in place for managing our free and safe access to this resource."

A start on the problem was made when the Civil Aeronautics Board delegated to the Civil Aeronautics Administrator final authority in the designation of restricted areas.

Prior to this action, the air space had been controlled by the Administrator with the assistance of the Air Space Panel of the Air Coordinating Committee. Because unanimous consent of the panel members was needed however, some of the compromises that resulted were in conflict with the public interest, the Board noted.

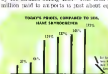
The airlines strongly support the new procedure and are in accord with the Civil Aeronautics Board's position that it is a "major forward step in determining how air space will be used," and that it "will resolve the conflicts that arise between the various users of air space."

Airport Rentals and Landing Fees

For the last ten years, the airlines have been paying steadily increasing landing fees to airports. At one large city, they have gone up in that period from 4.4 cents to 16 cents per 1,000 pounds; at a medium size city, from 3.3 cents to 8.8 cents, and at a smaller city, from 3.3 cents to 9.4 cents.

In 1957, the domestic trunk and local service airlines paid out an estimated $14 million in landing charges.

To this figure must be added an estimated $10 million representing rental payments made by the airlines during 1957. This total of $24 million paid to airports is just about equal to



the net profit of the domestic industry for the year.

JET PROGRAM THREATENED BY FINANCIAL SQUEEZE

At the end of the year, the scheduled airlines had on order 474 new aircraft for delivery between 1958 and 1961.

Making up the airline order were 230 pure jet planes, 167 turbo-props, 70 piston aircraft and seven helicopters.

The equipment orders represent an investment of more than $2.5 billion. This investment became all the more important when the end of 1957 saw the beginning of a recession that forced many industries to cut back on capital expenditures.

The airlines' re-equipment program will go a long way toward the priming of the pump of American industry, providing new jobs, creating new skills, and spreading its revitalizing energy throughout the whole economy.

Airline estimates indicate that 30 per cent of all traffic will be flying in turbine-powered aircraft by the end of 1959 and that the new jets will be the basic airline aircraft by 1961. The Civil Aeronautics Administration predicts that by 1965, domestic volume will reach 93 million passengers, almost twice the amount carried in 1957.

With the introduction of the jets, the public will be able to fly faster and more comfortably than ever before. The world will be shrunk to a little more than half its present size and time will be reckoned not in hours, but in minutes.

Shippers will see their goods being moved across the country and over oceans in half the time. The enormous lift capacity of the new jets will open up new dimensions for cargo movement that have only been hinted at so far. The mail will move faster, more often, and in greater quantity.

At the same time that the airlines were placing this bet on the future of their industry, they were beset by a financial squeeze that grew increasingly severe.

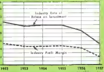
The profit margin for domestic trunk lines was 1.9 per cent in 1957, compared to 7 per cent in 1952. The operating profit margin was 5.4 cents per available ton mile for 1951 but it had dipped to .8 cents by 1957. Operating margin per revenue ton-mile was 8.9 cents for 1951, compared to 1.5 cents for last year.

Since 1938, the average revenue per passenger mile has gone down from 5.32 cents to 5.25. During that same time, the overall cost of living went up 98 per cent, bus tickets went up 37 per cent and rail freight rates went up 46 per cent.

Despite the fact that virtually every trunk airline filed requests for fare increases ranging from 12 to 17 per cent, the Civil Aeronautics Board granted, in early 1958, only a 4 per cent increase with a $1 service charge per ticket.

The inadequacy of the increase can be seen in the comparison of profit margins over recent years. Last year, as noted, the profit margin was 1.9. With the recent increase, it is estimated that the profit margin for 1958 will be only 2.61, a long way down from the 4.6 per cent of 1956, or the 7 per cent of 1952. The estimated gross revenues for 1958 will more than double those of 1952, but the profit margin will be a good deal less than half.

The earnings decline has affected not only the domestic trunk lines, but the entire industry as well. The rate of return on investment for the scheduled airlines dipped from 10.9 per cent in 1952 to a low of 5.1 for 1957. Industry profit margins fell off similarly, going from 5.3 per cent in 1952 to a dangerously low level of 2.0 per cent for 1957.



AVAILABLE SERVICE AND UTILIZATION

U. S. Scheduled Airline Industry

(For Selected Years In Millions)

THIS TABLE SHOWS THE EVER INCREASING GROWTH IN THE SERVICES THE SCHEDULED AIRLINES ARE OFFERING TO THE PUBLIC AND THE INCREASING USE OF THIS SERVICE BY THE PEOPLE THE GOVERNMENT AND SHIPPERS

LOAD FACTOR IS THE PERCENTAGE OF CAPACITY WHICH IS SOLD.

	Available Ton Miles Flown	Revenue Ton Miles Flown	Ton Mile Load Factor (%)	Available Seat Miles Flown	Revenue Passenger Miles Flown	Passenger Load Factor (%)	Revenue Plane Miles Flown
Domestic Trunk Airlines							
1938	N.A.	53.5	....	908.4	457.3	50.35	65.4
1946	982.2	637.9	64.95	7,490.4	5,903.1	78.81	304.5
1948	1,357.9	700.7	51.60	9,980.2	5,822.4	58.34	316.3
1950	1,684.1	953.5	56.62	12,385.6	7,766.0	62.70	327.1
1952	2,399.3	1,397.4	58.24	18,068.1	12,120.9	67.08	411.4
1953	2,893.4	1,624.9	56.16	22,114.8	14,297.6	64.65	467.0
1954	3,314.1	1,832.6	55.30	25,646.5	16,246.3	63.38	497.2
1955	3,882.7	2,160.1	55.63	30,001.3	19,217.2	64.08	564.0
1956	4,393.2	2,417.0	55.02	33,752.6	21,643.1	64.12	622.1
1957	5,150.4	2,720.0	52.81	39,838.2	24,499.5	61.50	711.1
Local Service Airlines							
1938[1]	....	....	....	....	....	....	....
1946	1.8	.7	41.71	18.0	6.8	37.92	3.0
1948	31.8	9.3	29.46	323.9	87.9	27.14	18.0
1950	62.4	20.6	33.02	599.2	188.8	31.81	33.0
1952	96.2	36.0	37.37	905.4	339.2	37.46	41.1
1953	109.3	41.1	37.61	1,013.6	390.9	38.56	48.6
1954	112.9	47.5	42.04	1,069.7	449.5	42.02	47.7
1955	121.9	55.3	45.36	1,161.4	523.3	45.06	50.9
1956	145.6	66.8	45.91	1,385.0	633.2	45.72	59.5
1957	170.7	78.4	45.95	1,653.8	747.3	45.19	67.3
Territorial Airlines							
1938	N.A.	.4	..	6.7	4.2	63.07	.6
1946	6.1	3.7	60.59	48.1	38.0	79.04	2.3
1948	9.1	5.1	56.24	81.0	52.9	65.28	3.6
1950	10.9	5.7	52.20	100.1	57.7	57.66	4.3
1952	14.2	7.1	50.03	124.1	67.9	54.72	5.4
1953	15.9	7.4	46.34	134.6	71.8	53.37	4.9
1954	15.7	7.6	48.46	134.5	72.7	54.04	4.7
1955	16.1	8.4	52.10	134.7	78.1	57.99	4.6
1956	16.0	8.5	53.03	147.9	83.9	56.70	4.6
1957	15.9	9.0	56.31	154.9	89.5	57.78	4.7
Helicopter Airlines *(in thousands)*							
1938[1]	....	....	....	....	....	....	....
1946[1]	....	....	....	....	....	....	....
1948	108	28	25.93	....	....	....	284
1950	189	63	33.33	....	....	....	668
1952	181	75	41.44	....	....	....	631
1953	350	129	36.86	191	26	13.61	1,006
1954	388	152	39.18	716	183	25.56	1,071
1955	434	195	44.93	1,708	628	36.77	1,148
1956	567	277	49.03	3,561	1,588	44.59	1,315
1957	1,056	450	42.61	8,049	3,273	40.66	1,604

See Footnotes at Bottom of Page 14

April 21 1958

Available Service and Utilization
(continued)

	Available Ton Miles Flown	Revenue Ton Miles Flown	Ton Mile Load Factor (%)	Available Seat Miles Flown	Revenue Passenger Miles Flown	Passenger Load Factor (%)	Revenue Plane Miles Flown
International and Overseas Airlines							
1938		57.2[2]	—	116 1	53.2	45 83	7 0
1946	211 7	145.1	68 55	1 553 7	1 100.7	70 85	59 4
1948	480 8	282.2	58.69	3 292.3	1 888 9	57 37	98 1
1950	554 2	334 5	60 35	3 695 4	2 206 4	59 71	93 8
1952	693 7	434 2	62 59	4 848 8	3 019 8	62 28	103 4
1953	760.5	474 4	62.38	5 462 2	3 381 1	61 90	109 6
1954	856 1	534.2	62 40	6 254 9	3 743 3	59 86	116.1
1955	984 6	633.8	64 37	7 012 1	4 410 8	62 90	130 7
1956	1 143 4	741.2	64 82	8 073 1	5 113 2	63 34	146.0
1957	1 292 9	854.7	66 10	9 038 1	5 751 7	63 64	185 7
Alaskan Airlines							
1938[1]		—	—	—	—	—	—
1946[1]	—	—	—	—	—		—
1948	20 1	13.0	54 37	42.6	19 6	46 10	4 6
1950	19 7	10.2	51 79	54 0	22 4	41.60	8 4
1952	26.7	14 6	54.51	168.8	71.2	42 18	9 3
1953	34 1	19.6	57 49	209.2	92 4	44 15	10 4
1954	34 4	19.6	56 91	206 3	87 0	42 15	9.6
1955	46 0	29 4	63 87	233 9	110 4	47 20	10 5
1956	66 9	44 8	66 98	284 1	137 0	48 21	11 3
1957	59 0	32 9	55 68	329.7	151.9	46.07	11.6
All Cargo Airlines							
1938[1]	—	—	—	—	—	—	
1946[1]				—	—	—	—
1948[1]	—			—	—	—	—
1950	80.2	59 5	74 20	—	—	—	13 0
1952	118 6	97 0	81 82	—	—	—	17.8
1953	121 9	99 3	81.51	—	—	—	17 6
1954	108 8	88 6	81 48	—	—	—	12.6
1955	184 0	135 1	73 41	—	—	—	17 1
1956	321.5	248 8	77 38	—	—	—	23 5
1957	431.7	336 9	78 04	—	—	—	23 3
CONSOLIDATED INDUSTRY							
1938	—	111 1[2]	—	1,031.2	514 8	49 92	73 0
1946	1,201.7	787 8	65.53	9,110.2	7,048 7	77 37	869 3
1948	1 899 4	1,010 2	53 18	13,720 0	7 871 7	57.38	440 9
1950	2 411.7	1,384 1	57 39	16,834 2	10 241 4	60 84	477 2
1952	3 349 8	1,986 3	59 31	24 115 2	15 618 9	64.77	589 1
1953	3,935 3	2 266 0	57 60	28 934 5	18 233 8	63 02	656 1
1954	4,442 5	2,530 3	56 96	32 342 7	20 599 0	61.70	608 9
1955	5,235 7	3,022 2	57 72	38 565 1	24 340 4	63 15	779 0
1956	6,087.1	3,527 4	57 95	43,646 3	27,612 0	63 26	868 4
1957	7,121 7	4 032 3	56.62	51,022 6	21 243 1	61 23	975.3

[1] Data not available for Alaskan airlines in 1938 and 1946. Local Service operations initiated in 1945. Helicopter operations started in 1947, passenger service began in 1953. All Cargo Airlines began operations in fourth quarter of 1949.

N.A. Not available.

[2] Revenue Ton Mile data for items other than passenger ton miles for International and Overseas carriers not available for 1938, hence total does not reflect these items.

Note: Available Ton Miles and Revenue Ton Miles includes charter operations, all other items are for scheduled service only.

REVENUE TON MILES OF TRAFFIC CARRIED

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Revenue Ton-Miles)

THIS TABLE SHOWS BY CATEGORIES THE EVER INCREASING USE OF THE SCHEDULED AIRLINES BY PASSENGERS AND COMMERCE

	Passenger[1]	Priority U S Mail	Non Priority[4] U S Mail	Express	Freight	Charter Flights	Excess Baggage	Total
Domestic Trunklines								
1938	43 447	7 446			2 089[3]	n.a.	473	53 455
1946	560 796	32 878		23 652	14 433	n a	6,128	637 887
1948	553 127	37 510		29 769	70 438	3 158	6 657	700 659
1950	737 771	46 315		36 538	112 861	8 203	11 782	953 470
1952	1,151 475	68 296		40 375	117 128	8 593	11 512	1 397 379
1953	1 358 270	69,936	1,789	42 514	131 776	6 874	13 706	1 624 867
1954	1 543 399	69 098	11 103	40 122	144 276	8,317	16 288	1 832 603
1955	1 825 631	71 859	14 175	49 603	174 017	5 737	19 046	2 160 068
1956	2 056 098	77 788	13 891	49 709	190 592	5 911	23 055	2 417 044
1957	2 327 334	82 057	15 137	42 752	218 432	6 335	27 983	2 720 030
Local Service Airlines								
1938[1]	—	—	—	—	—	—	—	—
1946	647	60		24	—	n a	4	735
1948	8 353	334		190	265	90	39	9 271
1950	17 934	566		623	696	653	118	20 590
1952	32 223	912		894	1 116	653	168	35 966
1953	37 131	951	49	954	1 179	649	198	41 111
1954	42 703	976	250	1 043	1 158	1 108	224	47 462
1955	49,713	928	328	1 403	1 358	1 338	245	55 310
1956	60 156	1 192	344	1 687	1,624	1 520	320	66 843
1957	70 990	1 174	348	1 545	2 082	1,719	471	78 429
Territorial Airlines								
1938	403	3	—	—	9[3]	n.a.	3	418
1946	3 043	34	—	112	389	n a	98	3 676
1948	4 229	53	—	134	581	39	68	5 104
1950	4 620	65	—	119	529	304	86	5 593
1952	5 431	50	—	55	1 258	272	49	7 115
1953	5.748	57	—	n a	1 503	27	46	7 381
1954	8 817	58	—	n a	1 657	45	34	7.611
1955	6 250	59	—	n a	1,646	436	20	8 411
1956	6 710	63	2		1 475	236	17	8 503
1957	7.159	65	1	—	1,536	170	37	8 968
Helicopter Airlines								
1938[1]	—	—	—	—	—	—	—	—
1946[1]	—		—	—	—	—	—	—
1948	—	28	—	—	—	—	—	28
1950	—	63	—	—	—	—	—	63
1952	—	75	—	—	—	—	—	75
1953	2	123	—	—	2	—	2	129
1954	17	115	—	13	5	—	2	152
1955	60	95	—	31	5	—	3	198
1956	149	89	—	31	7	—	1	277
1957	309	91	—	35	14	—	1	450

See Footnotes at Bottom of Page 16

Revenue Ton Miles of Traffic Carried

(continued)

	Passenger[6]	Priority U S Mail	Non Priority[5] U S Mail	Express	Freight	Charter Flights	Excess Baggage	Total
International and Overseas Airlines[4]								
1938	57,199	n a	—	n a.	n a.	n a.	n a.	57,199[3]
1946	118 330	6,141	—	18 090	n.a.	n a.	8 557	145 118
1948	203 062	17,203	—	41 581	4,012	7,990	8,314	282 162
1950	237 188	21 188	—	44 513	16 050	5,730	9 825	334 494
1952	318 608	22 068	—	281	72 346	7 846	13 051	434 200
1953	352 963	24 466	—	219	74 427	7 700	14 583	474 358
1954	386 868	35 323		217	81 886	13 790	16 136	534 220
1955	453 195	52 409		243	90 598	19 701	17 648	633 794
1956	524 369	55 158			109 235	32,652	19 757	741 171
1957	589 510	57 265	—	—	123 280	63 833	20 771	854 659
Alaskan Airlines[2]								
1938[1]	—	—	—	—	—	—	—	—
1946[1]	—	—	—	—	—		—	—
1948	2 109	287	—	—	1 027	9 509	40	12 966
1950	2 413	741		—	882	6 095	90	10 221
1952	7,654	1,591		—	4 252	955	99	14 551
1953	9 928	1 987	—	—	5,908	1 640	114	19 577
1954	9 350	2 058	—	—	5,998	2 086	114	19 606
1955	11 868	2 279	—	—	7,300	7 773	182	29 372
1956	14 719	2 383	—	—	7 948	19 527	241	44 818
1957	14,328	2 702	—	—	7 208	6 348	279	32 865
All Cargo Airlines								
1938[1]	—	—	—	—	—	—	—	
1946[1]	—	—	—	—	—	—	—	—
1948[1]	—	—	—	—	—	—	—	—
1950	—	—	—	—	58 420	1 125	—	59 845
1952	—	—	—	—	92 367	4,670	—	97 037
1953	—	—	—	—	88 812	10,517	—	99 329
1954	—	—		—	76 653	11 988	—	88 641
1955	—	—	318	—	107 945	26 796	—	135 059
1956	—	381	1,188	1 266	140 420	105 526	—	248 781
1957	—	440	1,409	1,638	155,126	178,249	—	336 862
CONSOLIDATED INDUSTRY[4]								
1938	101 849	7 449	—	—	2 898[2]	—	476	111 072[3]
1946[1]	682 816	39 113	—	38 878	14 822	—	11,787	787,416
1948	778,880	55 409	—	71,674	76,323	20,786	15 118	1 018 190
1950	999,926	68 938	—	81 793	189,438	22,110	21 871	1 384 076
1952	1,515,391	92 992	—	41,685	288 467	22,989	24 879	1,986 323
1953	1 764 042	97,520	1,838	43,687	383 609	27 407	28 649	2 266 752
1954	1,988 154	107,628	11,353	61 395	311 633	37,334	32,798	2,530,295
1955	2,346,717	127 630	14,821	51,280	382 866	61,781	37,114	3,022,289
1956	2 662,201	137,854	15 425	52,693	451,301	165,372	43,391	3,527,437
1957	3,011 630	143,794	16 895	46 070	507 678	256 654	49,542	4,032,263

N.A Not available.

[1] Data not available for Alaskan airlines in 1938 and 1946. All Cargo airlines began operations in fourth quarter of 1949. Local Service operations initiated in 1945. Helicopter operations started in 1947.

[2] Express and Freight combined

[3] Revenue Ton Mile data for items other than passenger ton miles for International and Overseas carriers not available for 1938 hence total does not reflect these items

[4] Foreign mail carried by International and Overseas airlines is included in Excess Baggage. Therefore, it is also reflected in Consolidated Industry Excess Baggage data. Express and Freight figures of Alaskan carriers are combined and thus reflected in Consolidated Industry freight figures

[5] See definitions p 3

[6] Passenger ton miles were revised to conform with "standard" passenger weights as prescribed by the CAB effective Jan 1 1957.

OPERATING REVENUES

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Dollars)

THIS TABLE SHOWS THE DOLLARS OF SALES THE SCHEDULED AIRLINES EARNED FOR THE VARIOUS SERVICES THEY RENDER

		1938	1946	1948	1950	1952	1953	1954	1955	1956	1957 p
Domestic Trunk Airlines											
Passenger	$	24,336	272 573	334 736	430 098	671 257	775 782	872 834	1,021 855	1 142 197	1 286,722
U S Mail											
Priority	$	15,751	20,274	47 838	46 311	35 910	32 955	31 137	24 230	28 937	30 916
Non-Priority	$	—		—	—	—	342	2 096	2 708	2,654	2 855
Public Service Revenue[5]	$			—			3 156	4 081	3 192	2 609	1,127
Express	$	—	9,188	9,964	12 569	15 853	16 829	15 107	19 405	18 101	14 667
Freight	$	1 261[3]	4 065	13 825	21 698	25 529	29 341	33 009	39 605	42 173	49,911
Other	$	903	5 776	6,990	13 433	19 466	20 388	19 954	22 353	26 160	33 094
Total	$	42 251	311,893	413 353	524 109	768 015	878 793	978 218	1 133 348	1 262 831	1 4[illegible]2 292
Local Service Airlines[1]											
Passenger	$	—	315	4,667	10 303	19 766	23 306	27 673	32,840	40 166	47 464
U S Mail											
Priority	$	—	1,559	10,911	16 581	21,177	1,223	1,178	1,084	1,004	1 108
Non Priority	$	—	—	—	—	—	16	77	101	102	103
Public Service Revenue[5]	$		—	—	—		23,117	23 639	20 923	23 211	29 560
Express	$	—	13	72	230	417	463	496	665	775	725
Freight	$	—	N A	76	212	405	462	802	556	750	1 061
Other	$	—	44	195	544	614	771	1 150	1,281	1 704	1 597
Total	$	—	1,931	15 921	27,870	42,379	49,358	54,715	57 450	67,712	82 018
Territorial Airlines											
Passenger	$	825	2,706	3 888	4 105	4,433	4,771	5 270	5,686	6 042	6 938
U S Mail											
Priority	$	47	122	189	285	768	46	46	48	51	82
Non Priority	$	—	—	—	—	—	—	—	—	1	—
Public Service Revenue[5]	$		—		—	—	1 082	594	291	288	72
Express	$	—	112	134	125	63	N.A.	N.A.	—	—	—
Freight	$	17[3]	225	302	288	562	692	732	752	782	771
Other	$	5	216	137	410	420	135	148	337	266	481
Total	$	594	3 381	4 660	5,213	6 246	6 726	6,790	7,114	7 430	8,314
Helicopter Airlines											
Passenger	$	—	—	—	—	—	10	63	208	438	968
U S Mail											
Priority	$	—	—	372	791	1 033	1 892	296	250	234	237
Non-Priority	$			—	—					—	—
Public Service Revenue[5]	$	—	—	—	—	—	655	2 582	2 710	2 833	3 567
Express	$			—	—	—		35	100	115	101
Freight	$	—	—	—	—	—	4	16	23	28	36
Other	$				7	13	44	78	64	63	123
Total	$			372	798	1 046	2 605	3 070	3 355	3 711	5 032

See Footnotes at Bottom of Page 18

Operating Revenues
(continued)

		1938	1946	1948	1950	1952	1953	1954	1955	1956	1957 p
International and Overseas Airlines											
Passenger	$	4 435	91 417	151,338	160 673	212 458	232 539	284 234	294 828	342 553	377 563
U S Mail (Priority)	$	8 599	25 061	57 332	55 689	51 533	18 037	20 681	25 639	26 926	28 353
Public Service Revenue[2]	$				.....	..	35 709	28 511	1 583	8 308	868
Express	$		11 413	19,438	15 783	87	74	70	77	82	80
Freight	$	562[3]	N A	1 370	5 881	26 730	27 257	29 614	31 853	36 683	41 434
Other	$	1 557	18 863	19 756	22 105	24 110	23,670	25 739	30 324	38 113	39 824
Total	$	15 153	146 764	249 234	260 131	314 918	337 286	358 849	384 304	452 665	487 822
Alaskan Airlines[1]											
Passenger	$			2 492	2 758	5 857	6 818	6 479	8 162	10 200	11 064
U S Mail	$			1,530	2,939	7,524	9 060	2 099	2 333	2 477	2 559
Public Service Revenue[2]	$	—	—	—	—	—		7 127	5 618	6 241	5 791
Cargo[3]	$		..	529	639	1 474	1 851	1 837	2 464	2 754	2 599
Other	$	—	—	3 798	3 102	1 106	1 574	1 662	3 747	7 680	4 221
Total	$	—	—	8 349	9,438	15 961	19 300	19 204	22 324	29 352	26,234
All Cargo Airlines[1]											
Passenger	$	—	—	—	—	—	—	—	—	—	—
U S Mail											
Priority	$	—	—	—	—	—	—	—	60	144	203
Non-Priority	$	—	—	—	—	—	—	—	—	220	279
Public Service Revenue	$			—	—		—	—	—		
Express	$	—	—	—						447	640
Freight	$	—	—	—	8,850	14 498	14 825	13 958	18 640	25 564	30 821
Other	$			—	3 511	2 549	4 321	3 001	8 335	26 485	56 025
Total	$	—	—	—	12 361	17 047	19 216	16 959	27 035	52 860	87 668
CONSOLIDATED INDUSTRY[1]											
Passenger	$	29,296	367,811	497,121	607 937	913 771	1,043,283	1 166 555	1,363 579	1,541,596	1,720 719
U S Mail											
Priority	$	24 397	47,916	118 172	122 596	117 945	63 213	55,437	53 644	59 773	63 428
Non-Priority	$	—	—	—	—	—	358	2,173	2 809	2 977	3,237
Public Service Revenues[2]	$	—	—	—	—	—	63 719	66,534	34 317	43,490	48,685
Express	$	—	20,723	29,608	28,707	16,429	17,366	15,708	20 247	19,528	16,213
Freight[3]	$	1,840	6,519	16,102	37 568	69 198	74 432	79,668	93 893	98,734	126,333
Other	$	2 465	26,099	30,076	45 112	48 278	50 973	51 732	66 441	98 471	135 765
Total	$	57 998	468,959	691,079	839,928	1,165,612	1,313 284	1 437 995	1 634 938	1,874 561	2 116,380

p Preliminary.

N.A Not Available.

[1] Data not available for Alaskan airlines in 1938 and 1946. All Cargo airlines began operations in fourth quarter of 1949. Local Service operations initiated in 1945. Helicopter operations started in 1947.

[3] Express and Freight combined and are reflected in Consolidated Industry freight totals.

[2] Prior to October 1 1953 public service revenues were not segregated from service mail payments.

DISTRIBUTION OF OPERATING EXPENSES

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Dollars)

THIS TABLE SHOWS HOW THE AIRLINES SPEND THEIR DOLLARS TO INSURE FAST, SAFE, ECONOMICAL FLYING OPERATIONS AND EFFICIENT PASSENGER AND CARGO HANDLING

Explanation of New Classification of Operating Expenses

The classification of operating expenses is different from that used in prior years. Owing to a revision of the form on which the carriers report to CAB it is not feasible to bring forward beyond 1956 the expense tables previously published in Facts and Figures. For this reason the data shown herein for years prior to 1956 were recast for this publication into the format of the new reporting system—insofar as it was feasible to do so. The data shown for 1957 are as reported by the carriers. Although the "matching" of prior years' data with 1957 is not perfect it is considered adequate for general use where precision is not required.

The classifications of expenses employed in past issues of "Facts and Figures" were grouped as follows to fit the new format:

NEW CLASSIFICATION	OLD CLASSIFICATION
Flying operations	Flying operations
Maintenance	Direct maintenance—flight equipment Ground and indirect maintenance
Passenger service	Passenger service
Aircraft and traffic servicing	Ground operations
Promotion and sales	Traffic and sales Advertising and publicity
General and administrative	General and administrative
Depreciation and amortization	Depreciation—flight equipment Depreciation—ground equipment

As pointed out above this method of matching accounts is not perfect. The figures for 1957 differ in the following respects from those shown for 1956 and earlier.

1) "Amortization of other deferred charges," dispersed throughout the accounts for 1956 and before, is grouped in "Depreciation and amortization" in 1957.
2) "Legal fees and expenses," dispersed in several accounts prior to 1957 is all in "General and administrative."
3) Payroll taxes and employee welfare insurance included in "General and administrative" before 1957 are distributed to other appropriate accounts.
4) Airport ticket office expenses included in "Promotion and Sales" for earlier years is under "Aircraft and Traffic Servicing."
5) Route extension and development expenses not classified as operating expense in prior years are included in "Depreciation and Amortization," in 1957.

		1938	1946	1948	1950	1952	1953	1954	1955	1956	1957 p
Domestic Trunk Airlines											
Flying Operations	$	14 579	69 730	104 154	132 060	193 384	234 928	260 234	302 591	340 670	435 012
Maintenance	$	7 495	60 388	79 608	87 400	137,308	154 756	164 435	196 320	239 530	270 092
General Services & Administration											
Passenger Service	$	.....	26 895	29,151	30 870	47 045	53,115	58 235	72,996	83 953	95 819
Aircraft & Traffic Servicing	$	...	59 854	64,915	68 541	94 606	107 044	119,207	133,274	152 928	217,125
Promotion & Sales	$		43,231	55 011	62 645	89 133	103 499	114 149	134,706	159 366	157 662
General & Administrative	$		28,250	31,217	33 651	46,874	82 259	57 744	68 473	79 462	55 529
Total G.S & A	$	15,577[2]	158 230	180 294	198 707	277 658	318,917	349 338	409 449	475 709	525 835
Depreciation and amortization	$	5,666	28,773	47 212	46 371	64 842	87 820	104 755	101 709	106 321	146 932
Total Operating Expenses	$	43 317	317 121	411 278	461,538	672 892	790 421	878 789	1 010 069	1 162 230	1 377 871

See Footnotes at Bottom of Page 21

Distribution of Operating Expenses *(continued)*

Local Service Airlines[1]

		1938[1]	1946[1]	1948	1950	1952	1953	1954	1955	1956	1957 P
Flying Operations	$	—	497	4,433	8 330	13 394	15 748	17,246	18 080	21 616	26,487
Maintenance	$	—	569	3,403	5 256	8 601	10,075	9 618	10 384	12,610	16 604
General Services & Administration											
Passenger Service	$	—	30	840	1 090	1 944	2,218	2 389	2 687	3 385	4 009
Aircraft & Traffic Servicing	$	—	461	2 682	4 964	7 254	8 406	8 763	9,663	11 187	20 887
Promotion & Sales	$	—	125	1 439	3 241	6 040	7 439	8 344	9 287	11 399	6 076
General & Administrative	$	—	198	1 436	2 484	3 682	4 028	4 330	4 485	5 382	4 899
Total G S & A	$	—	814	6 097	11 784	18 920	22 091	23 816	26,022	31 353	35 871
Depreciation & Amortization	$	—	181	1,648	1 836	2 582	2 989	2,428	2 278	2,714	3 749
Total Operating Expenses	$	—	2,060	15,578	27,206	43 497	50 903	53 105	56 764	68 293	82 711

Territorial Airlines

		1938[1]	1946[1]	1948	1950	1952	1953	1954	1955	1956	1957 P
Flying Operations	$	159	579	946	1,221	1,623	1 875	1 908	1 942	2 033	2,204
Maintenance	$	117	697	960	942	964	1,107	1,245	1,278	1 259	1,379
General Services & Administration											
Passenger Service	$	—	98	140	190	213	210	198	245	252	274
Aircraft & Traffic Servicing	$	—	699	904	906	1 001	1 212	1 269	1,258	1,317	1,506
Promotion & Sales	$	—	259	483	832	1 048	911	909	1 045	1 182	1 287
General & Administrative	$	—	407	567	743	899	953	958	964	848	867
Total G S & A.	$	142[2]	1 463	2,094	2 671	3 161	3 286	3 331	3 512	3 599	3 904
Depreciation & Amortization	$	127	298	433	452	224	489	596	603	416	496
Total Operating Expenses	$	545	3 037	4,433	5 286	5 972	6 757	7,080	7,335	7 307	7 983

Helicopter Airlines[1]

		1938[1]	1946[1]	1948	1950	1952	1953	1954	1955	1956	1957 P
Flying Operations	$	—	—	94	205	264	541	583	614	647	1 108
Maintenance	$	—	—	89	182	337	701	808	871	981	1,381
General Services & Administration											
Passenger Service	$	—	—	—	—	—	11	15	21	21	—
Aircraft & Traffic Servicing	$	—	—	33	98	138	278	334	425	544	—
Promotion & Sales	$	—	—	2	2	3	43	107	180	312	—
General & Administrative	$	—	—	43	112	164	306	365	393	496	
Total G S & A.	$	—	—	78	212	308	638	821	1 019	1,373	1,765[3]
Depreciation & Amortization	$	—	—	85	133	144	487	426	451	605	911
Total Operating Expenses	$	—	—	346	732	1,050	2,367	2,638	2,965	3,656	5,165

International and Overseas Airlines

		1938[1]	1946[1]	1948	1950	1952	1953	1954	1955	1956	1957 P
Flying Operations	$	—	32,447	67 163	70 980	87 368	91 489	98 755	108 501	125 613	143 195
Maintenance	$	—	24 838	44 460	43 440	54,231	55 027	53,113	58,975	72 069	72 467
General Services & Administration											
Passenger Service	$	—	9 255	14,034	14 589	19 554	20 027	22 372	26 773	31,083	32 519
Aircraft & Traffic Servicing	$	—	27 787	31 005	31 618	39 726	42 189	43 397	46 990	51 583	67 007
Promotion & Sales	$	—	18 598	33 211	36 814	47 486	51 419	54 846	61 980	70 822	70 765
General & Administrative	$	—	16 365	22 887	22 170	26 754	27 931	28 970	31 291	33 808	24 427
Total G S & A.	$	—	71 975	101 137	104 891	133 520	141 566	149 585	167 034	187 266	194,718
Depreciation & Amortization	$	—	10,583	22 527	29 012	29 148	29 825	31 233	31 094	34 593	50 365
Total Operating Expenses	$	14 303[3]	139 843	235 287	248 323	304 267	317 907	332 686	365 604	419 541	460 745

See Footnotes at Bottom of Page 21

Distribution of Operating Expenses *(continued)*

Alaskan Airlines[1]

		1938	1946[1]	1948	1950	1952	1953	1954	1955	1956	1957 P
Flying Operations	$	—	—	3 138	3 020	4 634	5,479	5 224	7 191	9 959	8 982
Maintenance	$	—	—	1 448	2 365	4 667	4 592	4 577	5 273	5 744	6 013
General Services & Administration											
Passenger Service	$	—	—	268	358	694	797	696	773	964	874
Aircraft & Traffic Servicing	$	—		845	966	2 182	2 449	2 612	2 701	3,702	3,058
Promotion & Sales	$			537	634	1 379	1 661	1,649	1 593	1 831	1 027
General & Administrative	$			903	1 332	1 767	2 100	1,952	1 519	1,894	1,140
Total G S & A	$			2 553	3 290	6 022	7 007	6 909	6 586	8 391	9 958[3]
Depreciation & Amortization	$			931	1 028	1,005	1 165	1,395	1 120	1,364	1 600
Total Operating Expenses	$			8 070	9,703	16 328	18 243	18 105	21 706[3]	27 166[3]	26 553

All Cargo Airlines

		1938	1946[1]	1948	1950	1952	1953	1954	1955	1956	1957 P
Flying Operations	$				4 633	6 782	8,062	7 834	10 638	21,677	35 908
Maintenance	$			—	1,769	3 683	3,921	3,806	5 287	11,662	19 819
General Services & Administration											
Passenger Service	$	—	—	—	—		23	209	267	1 614	3 913
Aircraft & Traffic Servicing	$	—	—		1,033	2 383	2 844	2 812	3 896	6 353	12,712
Promotion & Sales	$	—	—	—	1,979	1,313	1 482	1,015	2 081	3 883	4,518
General & Administrative	$	—	—	—	1,047	1,182	1,760	1,969	2 103	3 454	5,193
Total G S & A	$	—	—	—	4,059	4,878	6 109	6 005	8 347	15 304	26 336
Depreciation & Amortisation	$	—	—	—	329	604	999	2,128	2 074	3 155	8,548
Total Operating Expenses	$	—	—	—	10 790	15,917	19,091	19,773	26,343	53 879[3]	90 311

TOTAL Scheduled Airline Industry

		1938	1946[1]	1948	1950	1952	1953	1954	1955	1956	1957 P
Flying Operations	$	14,738	103 253	179 958	220 469	307 419	358 122	391 784	469 556	522,265	652 896
Maintenance	$	7,612	86,491	129,968	141,254	209 791	227 179	237,599	278,388	343 855	387 455
General Services and Administration											
Passenger Service	$	—	36 270	44,133	47,897	69,450	76 481	84 114	103,762	121,242	137 108
Aircraft & Traffic Servicing	$	—	88 771	100 284	108,121	147,298	164,422	178 384	198 107	227 614	322,295
Promotion & Sales	$	—	62 213	90 683	105 867	166,402	166 656	181 019	210 072	240 795	241,805
General & Administrative	$	—	65 220	57 053	61,539	81 322	89 337	96 285	109 228	125,344	92 055
Total G S & A	$	15,719[3]	222 482	292 252	222,614	444 464	496 614	539 802	621,969	722 995	798 387[3]
Depreciation & Amortization	$	5 793	39,835	72,833	79 161	98 269	123 774	142 961	139 329	149,148	212,601
Total Operating Expenses	$	50 165[3]	662,061	674,992	763 578	1,059,923	1 205 689	1 212,146	1 490 776[3]	1,742 072[3]	2 051 339

P Preliminary

[1] Data not available for Alaskan airlines in 1938 and 1946. All Cargo airlines began operations in fourth quarter of 1949. Local Service operations initiated in 1945. Helicopter operations started in 1947.

[2] Detailed expense breakdown not available 1938

[3] Total is greater than sum of individual expense categories since segregation of expenses was not reported by some of the carriers.

SUMMARY OF PROFIT OR LOSS

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Dollars)

THIS TABLE SHOWS THE AMOUNT OF DOLLARS THE AIRLINES WERE ABLE TO KEEP FOR PURCHASE OF NEW AIRCRAFT AND PAYMENT OF DIVIDENDS TO STOCKHOLDERS IT ALSO SHOWS THESE DOLLARS AS A PER CENT OF SALES AND THE RATIO OF TOTAL RETURN TO INVESTMENT

		1938	1946	1948	1950	1952	1953	1954	1955	1956	1957 P
Domestic Trunk Airlines											
Total Operating Revenues	$	42 251	311 893	413 353	524 109	768 015	878 793	978 218	1 133 348	1 262 831	1 419 272
Total Operating Expenses	$	43 317	317 121	411 278	461 538	672 892	790 421	878 759	1 010 069	1,162 230	1,377 871
Net Operating Income	$	(1 066)	(5 228)	2 075	62 571	98 123	88 372	99 489	123 279	100 601	41,421
Interest on Long Term Debt	$	N A	N.A.	4 246	4,331	5,162	6 585	6 908	6 540	9 964	16 201
Net Other Non Operating Income	$	N.A.	N.A	758	1 065	12 853	14 187	9 509	16 388	23 917	24 372
Income Taxes	$	N.A.	(513)	3 883	28 940	49 280	47 624	50 670	70 024	56 842	23 045
Net Profit or Loss	$	N.A	(5 627)	(4 996)	30 365	53 534	48 380	51 490	63 103	57 712	26 54
Rate of Return on Investment[2] (%)	$	—	—			14 1	11 8	11 2	11 8	9 4	4 8
Profit Margin on Sales[3] (%)	$	—				7 0	5 5	5.3	5 6	4 5	1 9
Local Service Airlines[1]											
Total Operating Revenues	$	—	1 931	15 921	27 870	42 379	49 358	54 718	57 450	67,712	82 018
Total Operating Expenses	$		2 060	15 578	27 206	43 497	50 903	53 105	56 764	68 293	82 711
Net Operating Income	$	—	(129)	343	664	(1 118)	(1 545)	1 610	866	(581)	(693)
Interest on Long Term Debt	$	—	N.A.	97	86	157	252	145	219	376	224
Net Other Non Operating Income	$		N A	(732)	(764)	930	(283)	(252)	369	106	(105)
Income Taxes	$	—	12	94	390	141	(47)	255	484	(50)	7
Net Profit or Loss	$	—	(287)	(580)	(866)	(486)	(2 033)	958	352	(801)	(1 030)
Rate of Return on Investment[2] (%)	$		—	—	..	—		11 1	2 7	—	—
Profit Margin on Sales[3] (%)	$				..	—		1 8	0 6	—	—
Territorial Airlines											
Total Operating Revenues	$	594	3 381	4 650	5 213	6 246	6 726	6 790	7 414	7 430	9 314
Total Operating Expenses	$	545	3 037	4 433	5 286	5 972	6 757	7 080	7 335	7,307	7 983
Net Operating Income	$	49	344	217	(73)	274	(31)	(290)	(221)	123	331
Interest on Long Term Debt	$	N.A.	N.A.	— —	1	8	117	129	106	97	109
Net Other Non Operating Income	$	N A	N.A	(50)	(61)	(15)	139	(35)	210	(14)	37
Income Taxes	$	N.A	142	65	3	88	(81)	(27)	8	—	19
Net Profit or Loss	$	N A	181	102	(138)	166	41	(427)	(125)	12	240
Rate of Return on Investment[2] (%)	$		—	—	—	8.7	3.9	—	—	3.3	10 5
Profit Margin on Sales[3] (%)	$	—	—	—	—	2 7	0 6	—	—	0.2	2.9
Helicopter Airlines[1]											
Total Operating Revenues	$	..	—	372	798	1,046	2 605	3 070	3 355	3 711	8 032
Total Operating Expenses	$		—	346	732	1,050	2 367	2 638	2 955	3 656	8 165
Net Operating Income	$		—	26	66	(4)	238	432	400	55	(133)
Interest on Long Term Debt	$		—	1	..	4	9	11	11	23	84
Net Other Non Operating Income	$		—	(29)	(30)	(42)	(61)	(68)	185	(63)	34
Income Taxes	$		—	—	8	31	68	165	202	8	(51)
Net Profit or Loss	$	—	—	(4)	28	(81)	100	188	342	(39)	(112)
Rate of Return on Investment[2] (%)	$		—	—	—	—	4.2	6.0	10 0	—	—
Profit Margin on Sales[3] (%)	$		—	—	—		3.8	6 1	10.2	—	—

See Footnotes at Bottom of Page 23

Summary of Profit or Loss
(continued)

		1938	1946	1948	1950	1952	1953	1954	1955	1956	1957 P
International and Overseas Airlines											
Total Operating Revenues	$	15 153	146 754	249,234	260 131	314,918	337 286	358 849	384 304	452 665	487 822
Total Operating Expenses	$	14 303	139 843	235 287	248 323	304 267	317 907	332 686	365 604	419 541	460 745
Net Operating Income	$	850	6 911	13 947	11 808	10 651	19 379	26 163	18 700	33 124	27 077
Interest on Long Term Debt	$	N A	N A	797	2 524	1 816	2 359	2 689	1 700	3 000	4 882
Net Other Non Operating Income	$	N.A.	N.A.	(4 370)	4 347	5 645	6 373	6 250	6 754	8 169	9 947
Income Taxes	$	N A.	2 634	2 415	3 623	6 651	10 865	12 924	10 320	17 792	13 474
Net Profit or Loss	$	N.A.	(4 353)	6 365	10 008	7 729	12 528	16 800	13 434	20 501	18 668
Rate of Return on Investment[2] (%)	$				—	4 9	7 0	8 8	6 3	8 2	7 6
Profit Margin on Sales[3] (%)	$		..	—	—	2 8	3 7	4 7	3 8	4.5	3 8
Alaskan Airlines[1]											
Total Operating Revenues	$			8 349	9,438	15 961	19 300	19 204	22,324	29,352	26 234
Total Operating Expenses	$			8 070	9 703	16 328	18 243	18 105	21 706	27 166	26 553
Net Operating Income	$			279	(265)	(367)	1 057	1,099	618	2 186	(319)
Interest on Long Term Debt	$	—	—	32	35	90	105	100	76	222	362
Net Other Non Operating Income	$			(17)	(96)	379	(79)	125	228	(98)	573
Income Taxes	$			45	37	373	113	231	334	870	470
Net Profit or Loss	$		—	185	(433)	(461)	760	893	436	996	(578)
Rate of Return on Investment[2] (%)	$	—	— —	—	—	—	18 9	16 3	8 3	15 1	
Profit Margin on Sales[3] (%)	$	..	—	—	—	—	3 9	4 7	2.0	3 4	...
All Cargo Airlines[1]											
Total Operating Revenues	$	—	—	—	12 361	17 047	19 216	16 959	27 035	52 860	87 668
Total Operating Expenses	$	—	—	—	10 790	18 917	19 091	19 773	26 343	53 879	90,311
Net Operating Income	$		—	—	1 871	1,130	125	(2,814)	692	(1 019)	(2 843)
Interest on Long Term Debt	$			..		154	298	405	861	488	1 526
Net Other Non Operating Income	$		—	—	224	1 423	3,799	(185)	1 132	4,539	1 632
Income Taxes	$		—	—	591	709	1 357	(1 624)	80	1 210	1,280
Net Profit or Loss	$		—	—	1 204	1 690	2 269	(1,780)	1,183	1 822	(1 257)
Rate of Return on Investment[2] (%)	$		—	—	—	16 7	17.4		9 4	7.0	0 8
Profit Margin on Sales[3] (%)	$	—	—	—	—	9 9	11 8		4 4	3 4	

CONSOLIDATED INDUSTRY

		1938	1946	1948	1950	1952	1953	1954	1955	1956	1957 P
Total Operating Revenues	$	57,998	463 959	691,879	839,928	1,165,812	1,313,284	1 437,805	1,634 938	1,876 561	2,116 380
Total Operating Expenses	$	58,165	462,061	674,992	763 578	1 059,923	1,205,689	1,312 146	1 490 776	1,742,072	2,051,339
Net Operating Income	$	(167)	1,898	16,887	76,342	105,609	107,595	125,659	164,154	134 489	65,041
Interest on Long-Term Debt	$	N A	N A	5,173	6 977	7,388	9,695	10 287	9,213	16 170	23 360
Net Other Non Operating Income	$	N A.	N A.	(4 040)	4,695	21 073	24,074	15 344	25 236	36,556	36,489
Income Taxes	$	N A	2,275	6,202	33 592	57 273	59,929	62 594	81 452	76,672	38,265
Net Profit or Loss	$	N A	(10 086)	1 072	60 468	62 101	62 065	68 122	78 725	88,203	42 677
Rate of Return on Investment[2] (%)	$	—	—	—	—	10 9	9 9	10.8	10 0	8.8	5 1
Profit Margin on Sales[3] (%)	$	—	—	—	—	5 3	4.7	4.7	4 8	4 3	2 0

N.A. Not Available.
[1] Data not available for Alaskan airlines in 1938 and 1946. All Cargo airlines began operations in fourth quarter of 1949. Local Service operations initiated in 1945. Helicopter operations started in 1947.
( ) Denotes reverse item.
[2] Net income before interest and after taxes as percent of average net worth and long term debt.
[3] Profit as percent of revenues.
P Preliminary.

ASSETS, LIABILITIES AND STOCKHOLDERS' EQUITY

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Dollars)

THIS TABLE SHOWS THE FINANCIAL SITUATION OF THE SCHEDULED AIRLINES

Domestic Trunk Airlines[d]

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Assets							
Current Assets	$	15 008	152,382	204 018	358 375	439 827	392 408
Investments and Special Funds	$	2 363	81 140	60 080	36 818	146 147	139 140
Flight Equipment	$	32 308	176 453	374 803	782 816	1 097 044	1 283 959
Reserve for Depreciation and Maintenance	$	16 473	58 569	173 183	394 292	583 793	612 018
Ground Property and Equipment	$	b	46 636	94 476	143 166	180 613	197 051
Reserve for Depreciation	$	b	16 042	40 947	68 926	89 217	98 247
Other Property	$	331	19 648	5 736	16 131	41 359	40 282
Deferred Charges	$	1,791	15,323	16 361	9,211	13 264	25 036
Other Assets	$	704	129	1 195	1 217	6 308	
Total Assets	$	36 032	387,100	542 539	864 516	1,281 552	1 367 611
Liabilities and Equity							
Current Liabilities	$	4 507	105 661	130 107	241 942	333 876	303 139
Long Term Debt	$	3,758	89 837	135 842	185 093	324 071	360 687
Other Non current Liabilities	$	c	260	—			1 169
Operating Reserves	$	228	1 139	3 971	5 796	10 490	
Deferred Credits	$	1,105	9 298	17,327	12 533	37 646	52 127
Preferred Stock	$	630	40 000	60 499	71 000	16 592	15 960
Common Stock	$	20 196	52 897	62 970	69 360	88 555	107 391
Other Paid In Capital	$	11 782	46 990	64 644	91 645	178 058	212 255
Retained Earnings	$	(6 174)	41 018	67 179	207 947	291 872	315 182
Stockholders' Equity—Net	$	26 434	180 905	255 292	439 152	575 469	650 489
Total Liabilities and Equity	$	36 032	387 100	542 539	884 816	1 281 582	1 367 611

Local Service Airlines

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Assets							
Current Assets	$		1,926	7,446	11 927	14 873	14 722
Investments and Special Funds	$		917	549	559	1 438	2 297
Flight Equipment	$		2 321	10 055	17 693	26 105	31 780
Reserve for Depreciation and Maintenance	$		325	5 021	9 873	12 628	16 112
Ground Property and Equipment	$		445	2 666	4 763	8 795	6 355
Reserve for Depreciation	$		102	1 020	2 432	2 949	3 456
Other Property	$		492	235	404	3 692	1 294
Deferred Charges	$		574	1 884	1,018	1 564	1 976
Other Assets	$		190	(28)	14	35	
Total Assets	$		6 438	16 766	24,073	37 928	38 856
Liabilities and Equity							
Current Liabilities	$		1 988	6 527	10 666	17 431	20 007
Long Term Debt	$		500	1,485	1,931	7 800	8 408
Other Non current Liabilities	$						179
Operating Reserves	$		52	287	616	1,138	
Deferred Credits	$		236	148	42	303	194
Preferred Stock	$			440	300	920	163
Common Stock	$		1,409	6 500	6 420	5 871	6 775
Other Paid in Capital	$		2 785	4 193	4 654	4 891	4 975
Retained Earnings	$		(832)	(2,914)	(556)	(429)	(1 733)
Stockholders' Equity—Net	$		3 662	8 319	10 818	11,253	10,068
Total Liabilities and Equity	$		6 438	16 766	24 073	37 925	38 856

a. PAA reported net property and equipment only
b. Property and equipment not segregated from flight equipment.
c. Other non-current liabilities not segregated from long-term debt.
d. Balance sheet data for domestic trunk airlines reflects international as well as domestic operations.

Note: Owing to a change in the reporting requirements effective January 1 1957 data for 1957 are not strictly comparable with other years. However, the data have been altered so as to make them generally comparable.

Territorial Airlines

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Assets							
Current Assets	$	135	477	1,743	1 084	1,241	2 021
Investment and Special Funds	$	72	206	228	8	15	15
Flight Equipment	$	748	1 791	2 724	5 866	6 057	5 831
Reserve for Depreciation and Maintenance	$	478	683	1 858	2 562	2 9 0	3 170
Ground Property and Equipment	$	b	750	1 008	1 227	1 275	1 328
Reserve for Depreciation	$	b	282	486	737	847	918
Other Property	$	—	122	69	21	17	110
Deferred Charges	$	29	63	228	157	169	121
Other Assets	$	32		5			—
Total Assets	$	538	2,444	3 661	8 064	4 998	5 338
Liabilities and Equity							
Current Liabilities	$	38	649	921	1 468	1,520	1 816
Long Term Debt	$	2	83		1 725	1 702	1 703
Other Non-Current Liabilities	$	n					
Operating Reserves	$	25	15	61	15	41	
Deferred Credits	$		73	91	1	68	17
Preferred Stock	$						
Common Stock	$	448	932	2 768	2 461	1 981	1 981
Other Paid In Capital	$		360	372	132	832	832
Retained Earnings	$	28	332	(552)	(958)	(1 146)	(1 011)
Stockholders' Equity—Net	$	476	1 624	2 588	1 865	1 667	1 802
Total Liabilities and Equity	$	838	2 444	3 661	5 064	4 998	5 338

Helicopter Airlines

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Assets							
Current Assets	$	—	—	263	2 659	2 307	2 124
Investment and Special Funds	$	—	—	10	20	290	27
Flight Equipment	$	—	—	528	2 285	3 878	5 158
Reserve for Depreciation and Maintenance	$	—	—	286	1 176	1 645	2 185
Ground Property and Equipment	$	—	—	49	235	576	741
Reserve for Depreciation	$	—	—	21	105	197	279
Other Property	$	—	—	5	28	71	67
Deferred Charges	$	—	—	123	145	196	208
Other Assets	$	—	—	61	22		
Total Assets	$	—	—	732	4 113	5 476	8 861
Liabilities and Equity							
Current Liabilities	$	—	—	69	657	738	1 069
Long Term Debt	$	—	—	—	204	817	1 136
Other Non-Current Liabilities	$	—	—		—		
Operating Reserves	$	—	—		33	45	
Deferred Credits	$	—	—		14	69	92
Preferred Stock	$	—	—	320	256		
Common Stock	$	—	—	376	643	702	734
Other Paid In Capital	$	—	—		1 996	2 435	2 546
Retained Earnings	$	—	—	(32)	310	673	264
Stockholders' Equity—Net	$	—	—	663	3 205	3 810	3 564
Total Liabilities and Equity	$	—	—	732	4 113	5 476	5 861

International and Overseas Airlines[d]

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Assets							
Current Assets	$	3 368	98 283	94 012	100 188	111 560	117 935
Investment and Special Funds	$	3 915	19 576	8 632	21 274	37 987	43 727
Flight Equipment	$	16 514a	59 626	133 488	194 286	265 785	281 907
Reserve for Depreciation and Maintenance	$	1 150	18 315	55 498	91 398	114 074	132 220
Ground Property and Equipment	$	b	14 915	22 677	27 763	31 813	33 453
Reserve for Depreciation	$		7 024	11,738	16 751	18 614	20 232
Other Property	$	268	8 542	1,297	2 487	2 450	3 360
Deferred Charges	$	272	8 753	25 688	4 689	4 440	4 447
Other Assets	$	5 829		862			
Total Assets	$	29 016	187 356	219 123	242 538	321 347	332 377

(International and Overseas Airlines continued on next page)

See Footnotes at Bottom of Page 24

Assets, Liabilities and Stockholders' Equity

(continued)

International and Overseas Airlines

Liabilities and Capital

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Current Liabilities	$	4 005	39 401	52 647	81 624	92 352	97 703
Long Term Debt	$	1 000		41 250	29 675	83 406	85,351
Other Non Current Liabilities	$	122	69 308	224			2,723
Operating Reserves	$		16 999	8 784	3 706	3 584	
Deferred Credits	$	368	10,660	19 803	4 089	6 058	6 102
Preferred Stock	$		150	150			
Common Stock	$	9 534	16 815	10 910	13 747	13 792	13 802
Other Paid In Capital	$	10 886	21 518	62 829	63 120	63 460	63 529
Total Retained Earnings	$	2 851	12 805	25 665	47 261	59 119	63 591
Stockholders Equity—Net	$	23 521	50 988	99 415	123 544	135 947	140 498
Total Liabilities and Capital	$	29,016	187 356	219 123	242,538	321 347	332 377

Alaskan Airlines[1, 2]

Assets

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Current Assets	$	—	—	2 705	4 592	7 129	7 514
Investment and Special Funds	$	—	—	91	186	532	908
Flight Equipment	$	—	—	4 630	8 251	11,126	13 046
Reserve for Depreciation and Maintenance	$	—	—	3.127	5,307	5 539	6 161
Ground Property and Equipment	$	—	—	1 611	3 418	4 201	4 491
Reserve for Depreciation	$	—	—	635	1 335	1 808	2 070
Other Property	$	—	—	150	144	400	624
Deferred Charges	$	—	—	226	171	422	572
Other Assets	$	—	—	190	161	134	
Total Assets	$	—	—	5 841	10 281	16,597	18 924

Liabilities and Equity

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Current Liabilities	$	—	—	2 532	3 471	6 170	7 669
Long Term Debt	$		—	486	1.420	3 360	4 834
Other Non-Current Liabilities	$		—			—	19
Operating Reserves	$		—	314	371	276	—
Deferred Credits	$		—	56	157	42	60
Preferred Stock	$		—	84			168
Common Stock	$		—	2 036	2 886	3 152	3 034
Other Paid In Capital	$		—	2 960	3 588	3 613	3 615
Retained Earnings	$		—	(2 627)	(1 612)	(16)	(186)
Stockholders Equity—Net	$		—	2 453	4 862	6 749	6 642
Total Liabilities and Equity	$			5 841	10 281	16 597	18 924

All Cargo Airlines

Assets

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Current Assets	$		—	5 822	7 683	21 224	20 610
Investment and Special Funds	$		—	379	248	17 244	4 547
Flight Equipment	$			2 631	20 496	31 540	61.623
Reserve for Depreciation and Maintenance	$			833	6 153	9 188	13 840
Ground Property and Equipment	$		—	1 049	2 341	4 666	5 306
Reserve for Depreciation	$	—	—	561	1 110	1 833	2 261
Other Property	$			16	103	3 028	2 928
Deferred Charges	$			423	271	2 706	5 188
Other Assets	$					281	
Total Assets	$			8 926	23 879	69 668	84 101

Liabilities and Equity

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Current Liabilities	$			3 682	5 594	19 301	25 054
Long-Term Debt	$			1 531	7 262	16 813	26 173
Other Non-Current Liabilities	$						747
Operating Reserves	$	—		321	1,598	2,311	
Deferred Credits	$			45	52	2 277	2 972
Preferred Stock	$				992	1 441	1 437
Common Stock	$			4 183	5 117	6 863	7 568
Other Paid In Capital	$		—	3 135	2 352	14 341	15 916
Retained Earnings	$		—	(3 971)	912	6 321	4 498
Stockholders' Equity—Net	$			3 347	9 373	28 966	29,155
Total Liabilities and Equity	$			8 926	23 879	69 668	84 101

See Footnotes at Bottom of Page 24

Assets, Liabilities and Stockholders' Equity

(continued)

Consolidated Industry

Assets

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Current Assets	$	18 511	253 048	316 809	486,508	598 141	557 334
Investment and Special Funds	$	6 350	71.839	49 949	59,113	203 453	198 661
Flight Equipment	$	49,570	240 191	528 859	1 031,493	1 441 535	1,643 384
Reserve for Depreciation and Maintenance	$	18,101	74,892	239 803	510 761	699 797	785 706
Ground Property and Equipment	$	—	42 744	123 536	182,913	228 960	248 725
Reserve for Depreciation	$	—	23,450	55,408	91 396	115 465	127 443
Other Property	$	599	28,804	7 508	19 318	51,017	48,665
Deferred Charges	$	2 092	24 713	44 933	15 442	22 761	37 548
Other Assets	$	6 545	319	1 985	1,414	6 758	—
Total Assets	$	65,586	583,338	797 588	1,194,444	1.737 563	1,853 068

Liabilities and Equity

		1938	1946	1950	1954	1956	(Sept. 30) 1957
Current Liabilities	$	8,547	147 699	194 485	245,422	471,385	456,457
Long Term Debt	$	4,748	90 420	180 594	227,210	437,949	487 992
Other Non Current Liabilities	$	122	69 568	224	—	—	4 837
Operating Reserves	$	253	18 205	10 738	12,135	17 805	—
Deferred Credits	$	1,473	20 267	37 478	14,888	46 443	61 564
Preferred Stock	$	630	40 158	41 493	72 548	18 953	17 728
Common Stock	$	30 178	71 753	89 742	99 854	120,914	141 275
Other Paid In Capital	$	22 668	71,653	138 133	147 487	247 430	303 668
Retained Earnings	$	(3,295)	53 423	82 838	253 304	356 394	380 655
Stockholders Equity—Net	$	50.431	237 179	372 077	592 809	743 861	842 218
Total Liabilities and Equity	$	65,586	583 338	797 588	1,394,444	1 737 563	1.853 068

See Footnotes at Bottom of Page 24

DOMESTIC INTERCITY PASSENGER MILE MARKET

(For Selected Years, In Millions)

	1938	1946	1948	1950	1952	1953	1954	1955	1956	1957[r]
Pullman and Air Travel										
Rail Pullman (Class I)[1]	7,354	19 801	11 015	9,338	9 504	7,950	6 850	6 440	6,275	5,349
Air—First Class[2]	457	5 910	5 905	6 898	10 105	10 970	11 375	13 025	14 202	15 740
Air—Coach[2]			5	1 057	2 356	3 718	5 321	6 716	8 074	9 510
Total Air	457	5 910	5,910	7,955	12 461	14 688	16 696	19 741	22 276	25 250
Pullman and Air Combined	7 811	25 711	16 925	17 293	21 965	22 638	23 546	26 181	28 551	30 599
% Airline of Combined Total	5 85	22 99	34 92	46 00	56 73	64 88	70 91	75 40	78 02	82 52
Other Common Carriers										
Rail Coach (Class I II III)[3]	10 240	39 119	24 360	17 473	19 781	18 979	17 710	17 329	17,105	16 365
Intercity Motor Bus (Class I II III)[4]	8 800[5]	26,293	23 529	21,254	21 223	19 634	16 934	16 562	16 409[7]	16,023
Total	19 040	65 412	47 889	38 727	41 004	38 613	34 644	33 891	33 514	32 388
Total Common Carrier	26 851	91,123	64 814	56 020	62 969	61 281	58 190	60 072	62 058	62 987
% Airline of Common Carrier	1 70	6.49	9 12	14.20	19 79	23 98	28 69	32.86	35 89	40 09
Private Intercity Automobile[5]	226 279	253,570	287 400	402 843	495 547	529 174	548 763	585 800	617,700	685 400
Total Common and Auto Carrier	253 130	344,693	352,214	458,863	558 516	590 445	606,983	645 872	679,765	718 387
% Airline of Total Intercity Travel	18	1 71	1.68	1 73	2.23	2 49	2 75	3 06	3.28	3 51
Passenger Miles per Capita[6]	1 950	2 461	2,411	3 045	3 568	3,730	3 765	3 931	4,064	4 218

[1] 1938-1954 from Railroad Transportation 12/56 AAR p 19 1955 1956 from Transport Economics May 1957 p 14

[2] 1938 CAB Annual Airline Statistics 1938 44 Revised to Airport to Airport Mileages 1946-1952 CAB Handbook 1953-56 CAB Monthly Report Air Carrier Traffic

[3] Rail Coach Class I Same as No. 1 Excludes commutation Rail Coach Class II & III, 1938-56 Statistics of Railways of United States, ICC.

[4] 1946 1956 from Transport Economics, December 1957 p 9

[5] 1950-1956 Transport Economics May 1956 October 1957 1938-48 from Exhibit 915 ICC Docket MC-C-550 not comparable with 1950-57 Data

[6] Based on mid year population estimate by Census Bureau

[7] Preliminary. [r] Partially Estimated

REVENUE PASSENGERS CARRIED

U. S. Scheduled Airline Industry

(For Selected Years, In Thousands of Passengers)

	1938	1946	1948	1950	1952	1953	1954	1955	1956	1957[2]
Domestic Trunk Airlines	1,168	11,890	12 324	15,978	22,759	26,137	29 526	34,511	37,598	40 275
Local Service Airlines	—	25	426	969	1,736	2 032	2 423	2 897	3 453	3 949
Territorial Airlines	29	299	418	477	515	553	561	591	627	589
Helicopter Airlines	—	—	—			1	9	29	62	152
International and Overseas Airlines	109	1,041	1,373	1,675	2,362	2 682	2 888	3,376	3 886	4,065
Alaskan Airlines	—	—	111	144	194	220	225	264	315	309
TOTAL SCHEDULED AIRLINE INDUSTRY	1,376	13 255	14 652	19,243	27 566	31,625	35 632	41,623	45,943	49 339

[1] Alaskan data for 1948 thru 1950 includes charter flights Data prior to 1948 not available.
[2] Passengers reported on a different basis for 1957 from prior years, hence data not entirely comparable with prior years

AVERAGE REVENUE PER PASSENGER MILE

Intercity Common Carriers

(For Selected Years, In Cents per Mile)

	1938	1946	1948	1950	1952	1953	1954	1955	1956	1957[2]
Domestic Scheduled Airlines[1]										
Coach or Tourist	—	—	—	4 10	4 18	4 13	4 34	4 32	4.29	4 25
All Services	5 32	4 62	5.75	5.54	5 54	5.43	5 37	5 32	5 26	5.25
International Scheduled Airlines										
Coach or Tourist			—	—		5 77	5 53	n.a	n.a	5.77
All Services	8 34	8 31	8 01	7 28	7.04	6 88	6.79	6 68	6 70	6.56
Railroads, Class 1										
First Class[3]	2.37	2.45	3 01	3.25	3 35	3 38	3 35	3 31	3 39	3.48
Coach	1 86	1 82	2.29	2 47	2 53	2 53	2.50	2 47	2 56	2.71
Intercity Motor Busses	1.56[4]	1 66	1 74	1 88	2 02	2 06	2 07	2.06	2 12	2 15

[1] Trunk airlines
[2] Partly estimated
[3] Does not include payments to Pullman Company for seat, berth etc

[4] 1939—first year available
N.A. Not available
Note Average passenger fare is derived by dividing passenger revenue by passenger miles

AIRCRAFT OWNED

By U. S. Scheduled Airline Industry

(For Selected Years)

THIS TABLE SHOWS HOW THE SIZE AND TYPE OF AIRCRAFT USED BY THE SCHEDULED AIRLINES HAS IMPROVED OVER THE YEARS

Aircraft	Type	1938	1946	1952	1954	1956	[Feb 6] 1958
Boeing:	247D, 307B	39	12				—
	377		—	44	48	34	33
Convair:	240	—	—	113	102	100	100
	340	—	—	8	121	123	134
	440		—	—		19	31
Curtiss:	C46		n.a	75	60	94	75
Douglas:	pre DC 3	88					
	DC 3	75	536	419	339	356	330
	DC-4		200	165	155	143	93
	DC 6	—	—	195	251	299	345
	DC-7			—	61	132	207
Lockheed:	Electra	40	3	—			
	Lodestar		11	11	11	10	10
	Other early models	14	n a				
	Constellation		35	115	111	117	121
	Super Constellation			24	39	79	128
Martin:	130	2	—				—
	202		—	21	25	23	25
	404		—	96	100	97	85
Sikorsky:	(series)	26	—	—	—		—
Vickers:	Viscount					54	59
Other		33	n.a	17	20	25	27
Total Fixed Wing		317	799	1323	1443	1706	1803
Helicopters:							
Bell	B 47	—	—	6	6	7	6
Sikorsky	S-51	—	—	3	3	2	2
	S-55	—	—	5	11	8	12
	S-58	—	—	—		3	6
Total Helicopters		—	—	14	20	20	26

AIRCRAFT ON ORDER

U. S. Scheduled Airlines

(As of January 1, 1958)

THIS TABLE SHOWS HOW THE SCHEDULED AIRLINES WILL CONTINUE TO ADD NEW AND FASTER AIRCRAFT TO INSURE IMPROVED SERVICE FOR THEIR CUSTOMERS

Aircraft Type	Total on Order	Year of Delivery 1958	1959	1960	1961
Jet:					
Boeing 707	70	5	55	10	—
Boeing 720	11	—		11	—
Convair 880	49	—	2	41	6
Douglas DC-8	100	—	13	83	4
Prop Jet:					
Bristol Britannia	5	5	—	—	—
Fairchild Friendship	31	24	7	—	—
Lockheed Electra	116	14	76	26	—
Vickers Viscount	15	15	—		—
Piston:					
Douglas DC-6A, B	28	28	—	—	—
Douglas DC-7	38	38	—	—	—
Lockheed 1049H	4	4	—	—	—
Helicopter:					
Vertol 44B	5	5	—	—	—
S 58C	2	2	—	—	—

COMPARATIVE TRANSPORT SAFETY RECORD

Passenger Fatality Rate per 100,000,000 Passenger Miles
(For Selected Years)

	1938	1946	1948	1950	1952	1953	1954	1955	1956	1957
Domestic Scheduled Airlines										
Fatalities	25	75	83	96	46	86	16	156	143	30
Rate	5 47	1 27	1 40	1.21	37	59	10	.79	64	12
International and Overseas Scheduled Airlines										
Fatalities	7	40	20	48	94	2	0	2	9	40
Rate	13	3 51	1 02	2 10	2 98	06		.04	17	67
Motor Buses										
Fatalities	[2]	140	120	100	100	70	60	100	80	n.a
Rate	[2]	0 19	18	17	16	13	.11	.19	16	n.a
Railroad Passenger Trains										
Fatalities	79	115	52	184	14	50	23	19	57	16[3]
Rate	0 36	0 18	13	58	.04	16	08	.07	.20	.06[3]
Passenger Autos and Taxis										
Fatalities	16 000	15 400	15,200	17 600	22,600	23 500	22 500	24 700	26 100	n.a.
Rate	3 9	2 5	2 1	2 2	2 8	2 9	2.6	2 7	2 7	n.a

[1] Alaska data not included prior to 1948
[2] Motor Bus statistics included in Passenger Autos and Taxis
[3] Preliminary
n.a. Not Available.

COMPARISON OF RAIL AND AIR FARES WITH TRAVEL TIMES

CITY—PAIR	FARES Coach Air	Coach Rail	First Class[1] Air	First Class[1] Rail	TIME Air	TIME Rail
Boston—New York	$ 10 80	9.42	13.65	16.60	55	4:15
Detroit—Boston	$ 32 35	29 56	42.30	54 28[2]	2:25	15 30
Chicago—New York	$ 34 10[3]	35 55	47 95	61 72	2 25	15 30
New York—Miami	$ 46 80[3]	42.92	80 80	77 66	3 50	24 15
New York—Washington	$ 12 55	8 78	16.00	18 46	1 00	3 50
Los Angeles—New York	$ 104.00	89 87	166.25	161.60	7 42	56 05
Philadelphia—Atlanta	$ 30 35[3]	24 41	48.10	43 75	2 38	20 07
Chicago—Washington	$ 28.60[3]	30 00	40 35	52 98	2.05	18 20
Washington—New Orleans	$ 45 00[3]	34 49	67 55	61.59	3 11	24 10
Atlanta—Chicago	$ 28 05[3]	22.03	43.75	40 01	2 27	19:15
Atlanta—Dallas	$ 33 15[3]	24 99	53 45	44 84	2 28	26 40
Cincinnati—Miami	$ 42 95[3]	36 46	68 10	73 95	3 25	18 45
Cincinnati—Pittsburgh	$ 15 90	12.02	20 45	23 18	1 18	7:20
Chicago—Houston	$ 48 85[3]	32.97	71 35	59.67	4 15	22:55
Chicago—St Louis	$ 14 25[3]	5 80	18.25	17 05	1 13	5:30
Los Angeles—Chicago	$ 80 09	85.56	120.35	109 76	5 25	39 30
St Louis—New Orleans	$ 30 15[3]	19 43	42 85	36 41	2 45	14 30
Chicago—Kansas City	$ 20 80	12 66	28 20	24 02	1 35	8 40
Denver—Dallas	$ 38 05	23 03	50 00	42 41	4 45	17 20
Denver—San Francisco	$ 48 85	37 63	66 75	70.38	3 15	33 10
Dallas—San Francisco	$ 70.70	50 65	102.85	91 06	4 45	43 15
St Louis—Los Angeles	$ 76 95	56 18	109 15	101 77	4 55	47 45
St Louis—Phoenix	$ 66 55	47 68	89 40	86 49	5 17	32 50
Los Angeles—San Francisco	$ 15.05	14.35	23 95	25 90	1 32	9:45
Portland—Seattle	$ 8 15	6 05	10 75	12 86	44	4 00
Salt Lake City—Portland	$ 34 50	24 39	45 30	45 61	4 01	25 05

[1] Rail fare includes price of lower berth
[2] Roomette where no berth charge is shown on timetable
[3] Night coach all other air coach fares are day coach rates

CLASSES OF UNITED STATES COMMERCIAL AIR CARRIERS

At the present time there are seven recognized classes of air carriers in the air transport industry of the United States. This classification is used by the Civil Aeronautics Board in connection with the economic regulation of the industry and under the Civil Aeronautics Act is based largely on the scope of operations authorized or allowed by that Act. Classes One to Six have certificates of convenience and necessity and conduct regularly scheduled services

1. **The Domestic Trunk Lines** include those carriers which presently have permanent operating rights within the continental United States These rights derive largely from operations by present or predecessor companies antedating the Civil Aeronautics Act of 1938 which granted them "grandfather rights" There are currently twelve trunk lines, most of which operate high density traffic routes between the principal traffic centers of the United States.

American	Continental	National	Trans World
Braniff	Delta	Northeast	United
Capital	Eastern	Northwest	Western

2. **The Domestic Local Service Lines** have, with one exception, been certificated since 1945 These carriers operate routes of lesser traffic density between the smaller traffic centers and between these centers and principal centers The thirteen local service lines in 1957 were

Allegheny	Lake Central	Ozark	Southern
Bonanza	Mohawk	Pacific	Trans Texas
Central	North Central	Piedmont	West Coast
Frontier			

3. **The International and Overseas Lines** include all U S. flag air carriers operating between the United States and foreign countries other than Canada Some of these carriers conduct operations between foreign countries and some are extensions of domestic trunk lines into Mexico and the Caribbean.

Alaska	Eastern	Pan American	Trans Caribbean [2]
American	Mackey [2]	Pan American-Grace	Trans World
Braniff	National	Resort [1 2]	U M C A [2]
Caribbean Atlantic	Northwest	Samoan [2 3]	United
Delta	Pacific Northern	South Pacific [2 3]	Western

4. **The Territorial Lines** include two groups of carriers. The Insular Lines operate in the U S Island possessions in the Pacific and the Caribbean and the Alaskan Lines operate between the U S and Alaska and within Alaska.

INSULAR LINES	ALASKAN LINES			
	Operating between the U S and Alaska		Operators within Alaska	
Hawaiian	Alaska [4]	Pacific Northern [4]	Alaska	Howard J Mays [2]
Trans Pacific	Northwest [5]	Pan American [5]	Alaska Coastal	Northern Consolidated
			Bristol Bay [2 3]	Pacific Northern
			Cordova	Pan American
			Ellis	Reeve Aleutian
				Wien

5. **The Helicopter Airmail Lines** presently operate between airports, central post offices, and suburbs in New York, Chicago and Los Angeles Originally certificated as exclusive mail carriers they now fly passengers, air freight and air express These carriers hold temporary certificates and are considered to be experimental in nature

Chicago Helicopter Airways	Los Angeles Airways	New York Airways

6. **The All Cargo Lines** operate under temporary certificates authorizing scheduled cargo flights between designated areas in the U. S., and in one case to the Caribbean and in another in Europe.

AAXICO	Flying Tigers	Seaboard & Western
Aerovias Sud Americana	Riddle	Slick

7. **Non-Certificated Air Carriers** include a diversified group of operators who, with the exception of the air taxi operators and air freight forwarders are not authorized to engage in regularly scheduled service They are described in the CAB 1954 Annual Report as follows

Operators of various types of air services have been authorized by the Board through the exemption process, rather than through the requirement that a certificate of convenience and necessity be obtained As of December 31, 1957 this group includes

Supplemental and irregular transport carriers 43
Air freight forwarders 65

[1] Certificated cruise carrier
[2] Certificated non-mail carriers.
[1 2 3] Statistical data of these carriers are not included in the statistical tables.
[3] Not operating
[4] Statistical data of these carriers are included with Alaskan Airlines
[5] Statistical data of these carriers are included with International and Overseas Airlines.

AIR TRANSPORT ASSOCIATION OF AMERICA | **19TH EDITION** *Facts and Figures, 1958*

OFFICERS

Stuart G. Tipton, *President*
Milton W. Arnold, *V. P., Operations & Engineering*
Stanley Gewirtz, *V. P., Assistant to the President*
John Having, *V. P., Public Relations*
E. F. Kelly, *V. P., Finance & Accounting*
W. N. Martin, *V. P., Public Affairs*
J. L. O'Brien, *V. P., Personnel Relations Conference*
Leo Seybold, *V. P., Federal Affairs*
Robert L. Turner, *V. P., Traffic*
John E. Stephen, *General Counsel*
F. J. Macklin, *Assistant V. P., Traffic*
J. D. Durand, *Secretary*
J. F. Hintersehr, *Treasurer*

DIRECTORS

C. E. Beard (Braniff)
Nick Bez (West Coast)
J. H. Carmichael (Capital)
T. H. Davis (Piedmont)
J. S. Gleason (Chicago Helicopter)
W. A. Patterson (United)
W. L. Pierson (Trans World)
R. W. Prescott (Flying Tiger)
E. V. Rickenbacker (Eastern)
C. R. Smith (American)
J. T. Trippe (Pan American)
C. E. Woolman (Delta)

MEMBER AIRLINES

AAXICO Airlines, *Howard J. Korth, Pres., P. O. Box 875, Miami Int'l Airport Branch, Miami, Florida,*
Alaska Airlines, *Chas. F. Willis, Pres., 2320 Sixth Avenue, Seattle 1, Washington*
Alaska Coastal Airlines, *O. F. Benecke, Co-Manager, 2 Marine Way, Juneau, Alaska*
Allegheny Airlines, *Leslie O. Barnes, Pres., Washington National Airport, Washington 1, D. C.*
American Airlines, *C. R. Smith, President, 100 Park Avenue, New York 17, New York*
Bonanza Air Lines, *Edmund Converse, Pres., McCarran Field, P. O. Box 391, Las Vegas, Nevada*
Braniff Int'l Airways, *C. E. Beard, Pres., Love Field, Dallas 35, Texas*
***Canadian Pacific Airlines,** *G. W. G. McConachie, Pres., Sea Island Airport, Vancouver AMF, B. C., Canada*
Capital Airlines, *J. H. Carmichael, Chairman of the Board, Washington National Airport, Washington 1, D. C.*
***Caribbean Atlantic Airlines,** *Dionisio Trigo, Pres., P. O. Box 6035, Loiza Street Station, Santurce, Puerto Rico*
Central Airlines, *Keith Kahle, Pres., Meacham Field, Fort Worth 7, Texas*
Chicago Helicopter Airways, *John S. Gleason, President & Treasurer, 5240 W. 63rd Street, Chicago 38, Illinois*
Continental Air Lines, *Robert F. Six, Pres., P. O. Box 9063, Denver 16, Colorado*
Cordova Airlines, *Merle K. Smith, President & Gen. Mgr., P. O. Box 6203, Anchorage, Alaska*
Delta Air Lines, *C. E. Woolman, Pres. & Gen. Mgr., Atlanta Airport, Atlanta, Georgia*
Eastern Air Lines, *E. V. Rickenbacker, Chairman of the Board & Gen. Mgr., 10 Rockefeller Plaza, New York 20, New York*
Ellis Air Lines, *R. E. Ellis, Pres., P. O. Box 1059, Ketchikan, Alaska*
The Flying Tiger Line, *Robert W. Prescott, Pres., Lockheed Air Terminal, Burbank, California*
Frontier Airlines, *C. A. Myhre, Pres., Stapleton Airfield, Denver 7, Colorado*
***Hawaiian Airlines,** *A. D. Lewis, Pres., Honolulu International Airport, Honolulu 17, T. H.*
Lake Central Airlines, *Gwin Hicks, Pres., Weir Cook Municipal Airport, Indianapolis 44, Indiana*
Los Angeles Airways, *C. M. Belinn, Pres., Box 45155, Airport Sta., Los Angeles 45, California*
Mackey Airlines, *Joseph C. Mackey, Pres., Broward County Int'l Airport, Ft. Lauderdale, Florida*
Mohawk Airlines, *Robert E. Peach, Pres., Oneida County Airport, Utica, New York*
National Airlines, *G. T. Baker, Pres., P. O. Box NAL, Int'l Airport Branch, Miami 48, Florida*
New York Airways, *Robert L. Cummings, Jr., Pres., P. O. Box 426, LaGuardia Airport Station, Flushing 71, New York*
North Central Airlines, *Hal N. Carr, Pres., 6201 34th Ave., South Minneapolis 23, Minn.*
Northeast Airlines, *George E. Gardner, Chairman of the Board, Logan Int'l Airport, E. Boston 28, Mass.*
Northern Consolidated Airlines, *Raymond I. Petersen, Pres. & Gen. Mgr., 414 Fourth Avenue, Anchorage, Alaska*
Northwest Airlines, *D. W. Nyrop, Pres., 1885 University Avenue, St. Paul 1, Minnesota*
Ozark Air Lines, *Laddie H. D. Hamilton, Pres., Box 6007, Lambert Field, St. Louis 21, Missouri*
Pacific Air Lines, Inc., *John H. Connelly, Pres., San Francisco International Airport, San Francisco, California*
Pacific Northern Airlines, *A. G. Woodley, President, 1626 Exchange Building, Seattle 4, Washington*
Pan American-Grace Airways, *Andrew B. Shea, Pres., 135 E. 42nd Street, New York 17, New York*
Pan American World Airways, *J. T. Trippe, Pres., 135 E. 42nd Street, New York 17, New York*
Piedmont Airlines, *T. H. Davis, President, Smith Reynolds Airport, Winston-Salem 1, N. C.*
Reeve Aleutian Airways, *Robert C. Reeve, Pres. & Supt. Operations, 420 D Street, Box 559, Anchorage, Alaska*
Resort Airlines, *Harold L. Graham, Jr., Pres., Suite 326, 1346 Connecticut Ave., N. W., Washington 6, D. C.*
Riddle Airlines, *John Paul Riddle, Chairman of the Board, P. O. Box 535, Miami International Airport Branch, Miami 48, Florida*
Seaboard & Western Airlines, *Raymond A. Norden, Pres., 80 Broad Street, New York 4, New York*
Southern Airways, *Frank W. Hulse, Pres., 1140 Brown Marx Building, Birmingham, Alabama*
***Trans-Canada Air Lines,** *W. Gordon Wood, Vice President Traffic, Room 422, International Aviation Bldg., 1080 University Street, Montreal 3, Quebec, Canada*
Trans Caribbean Airways, Inc., *O. Roy Chalk, Pres., 200 W. 57th Street, New York 19, New York*
Trans Texas Airways, *R. E. McKaughan, Pres., 1221 Commerce Building, Houston 2, Texas*
Trans World Airlines, *Warren Lee Pierson, Chairman of the Board, 806 Connecticut Avenue, Washington 6, D. C.*
United Air Lines, *W. A. Patterson, Pres., 5959 S. Cicero Avenue, Chicago 38, Illinois*
West Coast Airlines, *Nick Bez, Pres., Boeing Field, Seattle 8, Washington*
Western Air Lines, *T. C. Drinkwater, Pres., 6060 Avion Drive, Los Angeles 45, California*
Wien Alaska Airlines, *Sigurd Wien, President & General Manager, Box 649, Fairbanks, Alaska*

*Associate Member

Printed in U.S.A.

AIR TRANSPORT ASSOCIATION OF AMERICA
1000 CONNECTICUT AVE., N.W., WASHINGTON 6, D. C.

DOUGLAS DC-8 jetliner in final production phase. Speed brake behind wing root will be installed on first test model only.

NIGHT VIEW emphasizes tapered nose section, swept-back wings. Aperture in nose is one of two air inlets for cabin air supercharger.

Douglas Uses Extra Time to Refine DC-8 for Jet Race

By Russell Hawkes

Santa Monica—Faced with competition which is first on the scene Douglas Aircraft Co.'s DC-8 is the product of carefully planned exploitation of advantages in being second and a ground test program which Douglas engineers believe to be unprecedented in scale and thoroughness.

Douglas says chief advantage in being second is the opportunity to build a newer airplane with later concepts in the basic design. It is recognized by every manufacturer competing in the turbine-powered transport field, as evidenced by hesitation to freeze designs until the last minute and willingness to design modified versions at the first opportunity. Optimistic Douglas technicians point out that the DC-3, the definitive example of success, was not the first of its class to see service.

In sales, lack of a flying prototype has been a disadvantage but the market for the DC-8 has been buoyed by Douglas' reputation for success and its far-flung customer service network. Unavoidable complexity of modern aircraft and the high cost of down time have made the Douglas service system a key factor in the sales competition and have made world-wide logistic support for the customer airline a priority target for transport builders.

Until now, delivery dates have been the most important single factor in determining which airplane an airline will buy. This can be demonstrated by a month-by-month comparison of the increase in backlog of Douglas and Boeing Airplane Co., the two most successful competitors in the pure jet field. Record shows that it becomes increasingly difficult for one to get an order when past successes make it impossible to promise delivery as early as the opposition. When one airline buys jets, lines which compete along the same routes are compelled to buy and must have delivery at the earliest possible date.

Because of the attraction and seat mile productivity of the jets, a line which fails to get early delivery can expect to measure its tardiness in passenger revenues lost.

JETLINER fuselage and wing are mated. DC-8 has fewer cabin windows than other jets, engineers feel additional window use does not justify fail safe weight.

First Deliveries

In this way, backlogs and delivery dates in Santa Monica and Seattle have advanced side by side through the first round of orders until there are reported to be only two major airlines in the world who have not yet bought long range jets. These are Northwest Air Lines and Canadian Pacific Airlines. Douglas now has 138 orders. First delivery will be made in the summer of 1959 before certification is complete to give customers opportunity for crew training before plane goes into service. First certificated airplane will be delivered in October, 1959.

Second round of orders for the big jetliners is not expected to be as large as the first, but may determine whether an airplane will score a financial success for its maker. Opening date for the second round will be decided primarily by the availability of financing. First round has nearly dried up air line credit reservoirs and time must be allowed for recuperation—even with the effects of the recent 6.6% fare increase allowed by the Civil Aeronautics Board.

Douglas experts, and presumably those of other manufacturers, predict that merit will be a far more decisive factor than delivery date in the second round since it will cost an airline less to wait once it has its first batch of jets operating.

SIX-ABREAST passenger seating arrangement shown here has been requested by some European airline operators. First class configuration features passenger lounge (forward).

Slim Profit Margin

Fierce struggle for the airline dollar has led airframe builders to trim profit margin per unit in the hope of making it up in volume sold. Trimming costs is a more difficult proposition. Douglas commercial transports cannot properly be described as mass produced because of the number of custom variations allowed. That always has been a big selling point because it allows a buyer to seek special advantages over his competitor but, according to Douglas chief engineer Ed Burton, it also is the toughest cost problem yet faced on the DC-8. He reports that the first 50 airplanes will include domestic and overwater models, three different powerplant systems and nine different customer configurations. The many one-shot engineering jobs tangle schedules and multiply administrative chores. However, Douglas experts believe that the sales appeal of custom equipment more than counterbalances cost factors.

Custom approach is especially valuable and especially troublesome in the realm of cabin interior design. Cabin is the showcase of the airline and the one place where the operator can demonstrate to the passenger that his DC-8 is better or at least different than his competitor's DC-8.

Because of this, airline operators have been willing to pay large sums to get custom interiors.

Douglas first began to consider jet transport designs in about 1945 but concluded that existing engines lacked the power and low specific fuel consumption needed to be economically practical. In 1951, when the Pratt & Whitney JT-3 (military J57) appeared on the horizon, Douglas and Boeing

began work on their respective jet transports.

Without military support for development there was little hope of beating competition into the air and Douglas began to figure ways of freezing design as late as possible to profit by the most recent ideas and discoveries available while still giving early delivery.

One of the first and most important steps was the decision to dispense with a prototype and design a production airplane immediately, using the first nine off the production line in an accelerated flight test program. This practice is not uncommon in the manufacture of civil transports and allows more time to study alternatives before the basic design is frozen. Douglas engineers decided that fundamental differences between a hand-made prototype and a production airplane were apt to be considerable and that successful operation of a prototype by crack test crews backed up by factory maintenance facilities, would prove little about its operation in the hands of airline crews in the field.

ATA Formula Used

Economic factors of DC-8 operation are computed on the basis of the 1955 Air Transport Assn. formula for evaluation of airplanes not yet in service. Usefulness of such methods for exact predictions is limited but formula is valuable as a yardstick for cost comparisons. Productivity of DC-8 is computed at 180 million seat-miles per year, three times that of the DC-7C. Average load factor in the U. S. has been a consistent 65% for some years.

DC-8 is being offered in domestic and overwater versions, but dimensionally the two are identical. Overwater version has been given intercontinental

DC-8 Specifications

Airplane weight empty (manufacturer's)	122,823 lb
Operator's items	7,941 lb.
Airplane weight empty (operating)	130,764 lb
Payload	35,680 lb
Zero fuel weight	166,444 lb
Fuel	121,056 lb
Maximum landing weight	194,000 lb
Maximum takeoff gross weight	287,500 lb
Maximum cruise speed (TAS) at 30,000 ft	513 kt
Maximum range	5,830 n.m.
Flaps down speeds, up to 20 deg	230 kt
—at 50 deg	149 kt
Gear down speed—lesser of	230 kt or Mach 0.46

JETLINER is prepared for roll-in to final assembly position. Target date for first flight is May 15 but Douglas officials say it may be delayed (AW April 14, p. 40).

ditional 26,100 lb. of fuel and by increasing strength of wing and landing gear. Maximum gross weight increases from 265,000 lb. for the domestic airplane to 287,500 lb. for the overwater version. Some of the overwater airplanes will be able to make nonstop westbound Seattle-Tokyo runs in the most adverse jet stream winds.

Maximum landing weight for overwater version is 194,000 lb. and that of the domestic airplane is 189,000 lb. Because of this, the chief difference in the operational requirements of the two is in takeoff field length.

No Preference

Douglas intends the DC-8 to operate in present traffic patterns and airports without preferential treatment, though marker beacon width may prove to be too small at jet transport cruise speeds. In mixed propeller and jet traffic, the DC-8 will be able to hold in a standard racetrack pattern 9.5 naut. mi. long at 5,000 ft. with an eight minute circuit time using a half-rate turn of 1.5 deg./sec. Speed would be 160 kt. or 1.5 times stall speed with 25 deg. of flap. Bank in the turns would be 13.5 deg. Fuel economy can be substantially improved by holding at higher altitudes. A recommended economical pattern would be 15.2 mi. long at 15,000 ft. with an eight minute circuit time and half-rate turns. Standard rate turns of three deg./sec. cannot be used because the high angle of bank needed would cause passenger discomfort.

Douglas claims traffic speeds for the DC-8 are very close to those for the DC-7. Final approach speed with 50 deg. of flap at maximum landing weight is 132 kt. Touchdown is at 121 kt. At weights below maximum landing weight, speeds are naturally lower. At 160,000 lb., the DC-8 will touch down at 112 kt.

DC-8 will make a 180 deg. taxi turn on a runway 88 ft. wide. A clear circle 180 ft. in diameter is needed for wing tip clearance in a taxi turn. Wingspan is 140 ft. Short turning radius despite four-wheeled bogie landing gear is made possible by mounting aft bogie beam of each landing gear on a swivel. Aft pair of wheels of a bogie will caster only when they are on the inside of the turn and when the nose wheel steering angle is greater than 45 deg. Arc traveled by the outside wheels is never great enough to scrub the tires sideways. Maximum nosewheel steering angle is 73 deg.

Much consideration was given to ways of minimizing turnaround time. Studies indicate that all servicing can be completed in 30 min. Fueling requires only 20 min. with pressure filling.

Two entry doors enable passengers to deplane in six minutes.

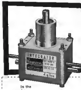
To prevent runway debris from being pulled into the engines during taxiing, Douglas engineers have invented an aerodynamic screen called a "blowaway jet." Studies showed that compressor suction creates a narrow vortex between intake lip and ground. Low pressure center of vortex is strongly intensified by drafts along the ramp surface and debris travels through this to the compressor. Low pressure blowaway jet merely dissipates the vortex. National Advisory Committee for Aeronautics and Douglas tests indicate the scheme will be effective against debris not blown up by engines of other aircraft.

Passenger Seating

DC-8 will carry 116 passengers with a five-abreast, first-class seating arrangement, 132 with mixed first-class and tourist accommodations, 140 coach, and 176 in the new economy class being asked for by some European operators. It is a six abreast arrangement with closer seat spacing.

A total of 13,900 lb. of cargo and baggage can be carried in pressurized compartments forward and aft. An animal compartment in the forward cargo space is provided with volume and air "adequate for the transportation of four large dogs."

Margin of time gained by late freez-



ing of the design was used by Douglas aerodynamicists to find what they regard as the best high subsonic wing yet developed for transport aircraft. Its basic design was not made final until 1955. To be competitive, the DC-8 must cruise at about Mach .85. Easiest and most conventional wing design for that cruise Mach number would be characterized by a 35 deg. sweep and short radius leading edge curvature, but these characteristics penalize low speed performance and structural strength.

Wing is a special Douglas design which is thicker and is swept back only 30 deg. at the quarter chord line. It developed from a seldom used technique of air flow analysis and an extensive wind tunnel program. Cost for all DC-8 wind tunnel tests now comes to $7 million and is continuing to grow. Wing and stabilizer semi-spans were tested independently from the rest of the airplane on some runs to get the benefit of higher Reynolds numbers.

Wing Evolution

Analytical method used a set of theoretical spanwise vortices to represent the wing in its function of controlling the flow of air to provide lift. Characteristics of the vortices were varied to create a required flow pattern and were then translated into a wing shape capable of duplicating the theoretical pressure and velocity distributions. This preliminary wing was then modified in small ways to find the best compromise between ideal pressure and velocity patterns and the many other lesser factors which affect the desirability of a wing design. Douglas aerodynamicists believe their approach to be unique in the industry, but Harold Luskin, Douglas assistant chief aerodynamicist, emphasizes that the airplane is part of world development in aerodynamics and not a single-handed achievement by Douglas.

Familiar problem for the aerodynamicists was to expand the difference between landing speed and cruise speed. DC-8 normal cruise is 57% greater than that of the DC-7 while its final approach speed is only 14% greater than that of the earlier airplane. This was made possible by the interaction of three factors:

- **Less sweep-back** than customary.
- **New understanding** of the relationship between leading edge shape and sudden drag rise at high subsonic Mach numbers embodied in the design.
- **Much-misunderstood** reverse camber airfoil.

Advantage of swept wings lies in creating a wasted spanwise component of flow over them. Mach number of component perpendicular to sweep angle is made less than free stream value. Direction and velocity of flow is controlled by pressure distribution on the wing. Lines of equal pressure should exactly parallel the span if the swept wing is to perform according to theory. In practice, swept wings have a much higher effective camber near the root than can be explained by the geometry of the airfoil profile, causing lines of equal pressure and velocity to slide aft of their appointed positions on the center section of the wing. Aerodynamically, the wing has less sweep than it does structurally. Effect spreads outboard as speed increases and is reinforced by the presence of the fuselage which also accelerates flow and increases effective camber near the wing root. Since the effect decreases with speed, the wing retains all the disadvantages of the full structural sweep back in slow flight.

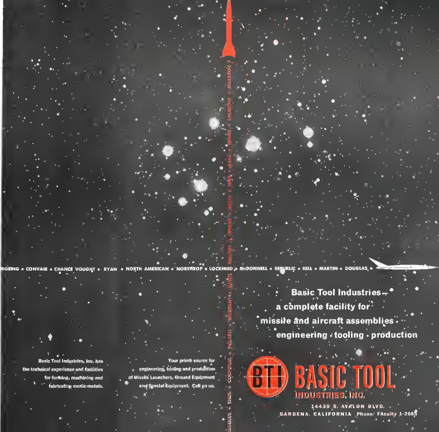
To combat this, Douglas aerodynamicists reduced the physical camber of inboard sections while increasing the camber of the outboard sections. Physical camber inboard must actually be negative to get effective camber down to the desired value. Tests show that the shape chosen holds the pressure-velocity pattern in the proper orientation. This has allowed Douglas to use a wing with only 30 deg. of sweep for low speed and structural advantages while sacrificing nothing at the high end of the speed scale.

Highly cambered outboard sections have blunt leading edges and very high maximum lift coefficients to ensure that they stall only at very high angles of attack. Inboard sections have relatively sharp leading edges and low maximum lift coefficients to make them stall at lower angles and earlier than the tips. The difference in airfoil profile at root and tip is supplemented by washout so that angle of attack at the tip is 1.5 deg. less than at the root. Because of the swept back planform, these features guarantee good pitch down as the wing begins to stall. They also are protection against inevitable asymmetry of the stall by giving the unstalled wing tips and ailerons a mechanical advantage over the stalled wing root.

Aileron Control

Spoilers are not used differentially for lateral control on the DC-8 despite the fact that Douglas has experience with this method on military designs. Douglas engineers feel that ailerons give adequate roll rate for a transport at all speeds.

According to orthodox belief, the thick wings of the DC-8 would bring on the sudden drag rise due to compressibility effects at a relatively low Mach number. At the time the DC-8 began to materialize, most aerodynamicists held that drag rise occurred at a Mach number closely linked to critical Mach number at which a shock wave begins to form somewhere on the



wing. Because of this it has been customary to design thin, sharp wings to minimize local accelerations of flow, preventing it from reaching Mach 1 at any point while most of the wing is subsonic.

Douglas learned from NACA that the connection between drag rise and critical Mach number is not as close as had been supposed. NACA studies, amplifying work done in Germany during World War II, showed that critical Mach number can be exceeded without encountering the drag rise until the shock wave moves aft to the crest line (the place on the upper surface of the wing at which the surface is tangent to the direction of flight).

As long as the shock is forward of the crest line it is unloading air into a region of converging flow and comparatively high absolute pressure. This minimizes pressure drop across the shock wave (pressure drag). When the shock passes the crest line it begins to unload into low pressure, expanding flow and pressure drag rises sharply. Also, the shock wave is shorter in the dense air of converging flow and results in a narrower turbulent wake.

Strength and Storage

Application of the crest line theory has enabled Douglas to use the high maximum lift coefficient outer sections and thick wings for greater strength and internal storage space. From root to tip, thickness ratios of the three airfoil profiles used are 12%, 10% and 10.2%.

To prevent losses due to interference in wing flow of the engine installations a cambered pylon was adopted which is streamlined into the S-shaped trajectors of air particles over the wing. Straight pylons were found to increase drag at speeds as low as Mach .4. At normal cruise, the drag of straight pylons amounts to about 20% of the total parasitic drag on the airplane. With the cambered pylons there is no apparent drag increase until Mach number exceeds that of cruise—about Mach .85.

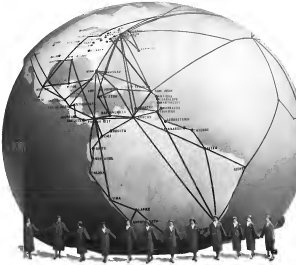
The 30% chord flaps on the DC-8 are an improved version of the double slotted type used on the DC-6 and DC-7 series and give as much additional lift as Fowler flaps with less pitching moment. Douglas calls them the most powerful completely aerodynamic trailing edge high lift device now in use. A special four-bar linkage permits greater chord extension in the takeoff position to give higher maximum lift coefficient. A reflex segment aft of the inboard engines automatically swings upward to clear the jet blast at flap angles greater than the 25 deg. takeoff setting. Use of the reflex segment, rather than a simple cut-out, increases

11:05 a.m. March 6, 1958 Test inflation of Pan Am's giant globe begins at New York's Idlewild Airport.

11:13 a.m. The Pan Am World begins to show signs of life—witnessed by over 200 members of the press.

11.25 a.m. Battery of air blowers pump away at the 100,000-cubic foot structure, now more than half filled

11:35 a.m. Mission completed. The World is fully inflated Later deflated, it was shipped by Clipper to Brussels the same day



How to walk around the world at the Brussels World's Fair

From now to October 19, America's colors are flying at the Brussels World's Fair And never more proudly

Upwards of forty million people from all over the world are expected to come together in an atmosphere of peaceful interchange. This is a powerful step toward improved understanding among nations

Pan American—the first 'round-the-world airline—believes there is no better way to do this

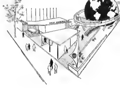
Indeed, bringing the peoples of the world together, *face-to-face*, has been Pan Am's most cherished objective in over 30 years of overseas flying.

One million people have crossed this bridge to understanding on the wings of the Flying Clippers*.

Now Pan Am has joined with 50 nations, seven international agencies, public and private organizations of six continents to create the first World's Fair of the Atomic Era At Brussels, the Pan American World is represented by a gigantic, inflated globe Built by the Irving Air Chute Co., this nylon globe, 52 ft. in diameter, is the biggest earth on earth! Continental land masses and islands of the world are painted on the outside along with the names of 143 of the cities served by Pan Am

Inside, 160 visitors at a time will be able to watch a demonstration of astral effects in the "theater of the stars," worked out with the co-operation of the Hayden Planetarium and Spitz Laboratories. A short film will also be shown dramatizing the change from Magellan's 'round-the-world cruise 400 years ago to the Jet Clippers of the first 'round-the-world airline.

After the show, the audience will exit through a door that leads to the "walk around the world" which sweeps out nearly 30 feet to ring the globe, affording an excellent view of the Pan American World and the surrounding fair grounds.



*TRADE MARK, REG. U.S. PAT. OFF.

The first responsibility of an airline is to be a useful citizen

PAN AMERICAN

payload for critical long range operations The flap is driven by multiple actuators to cut torque loads and save structural weight All flap segments are bussed together by a combination of mechanical and hydraulic means to prevent asymmetrical extension

Upper lip spoilers have four segments with a chord of about 16 in which deflect through an angle of 60 deg when the nosewheel touches down and compression of the shock strut closes an interlock Their only purpose is to destroy lift and get more of the airplane's weight onto the wheels for effective braking No speed brakes will be installed since it is expected that thrust reversers will be used to decelerate in flight

Control Characteristics

Douglas claims that stability and control characteristics of the DC 8 are as good as those of earlier Douglas transports

Engineers chose to use ailerons alone for lateral control since they are better than spoilers at very low speeds if stall characteristics are as good as those designed into the DC 8 Spoilers escape wing aeroelasticity at high speeds but this problem will be small enough with the stiff DC 8 wing to make the split aileron design an adequate solution Each aileron is split in two segments inboard segment is hydraulically powered and drives the outboard one through a pre-loaded torque link At low speeds aerodynamic hinge moments are less than the pre load and the two pieces operate as one unit As speed increases, hinge moments exceed the preload at progressively decreasing deflections Outer segment will not deflect beyond the preload limit and the system approaches that of inboard aileron control alone, effectively limiting torsion of the wing From takeoff to maximum speeds rate of roll is always at least 25 deg or about twice that of the DC-7C and its successful contemporaries

When hydraulic power fails at either aileron, that side automatically reverts to manual control operating through a cable system with an aerodynamic boost tab which is locked during powered operation On manual control only, aileron effectiveness and control forces are approximately equal to those of the DC 4

Chief problem in lateral stability is 'Dutch roll' (combined yaw and roll motion caused by rough air) due to poor aerodynamic damping of aircraft at high speeds and high altitudes Large airplanes have a fairly long period of oscillation—about 4-7 sec for the DC-8—but it is still undesirable Douglas engineers believe the critical DC 8 Dutch roll condition lies in an unsatisfactory region, so they have installed a simple yaw damper based upon a very sensitive accelerometer located in the tail Conclusion that this was needed was based upon flight tests of fighter designs with Dutch roll periods under 3 sec Since there is a question of the applicability of the data, it is possible the yaw damper will be taken out when flight tests are complete

Aerodynamic philosophy of the DC-8 regards tail surface design as more critical than wing design at high Mach numbers Compressibility effects on the wing are associated with a drag rise which tends to block the airplane out of dangerous speed regimes, whereas the same effects on the tail surfaces do little to limit speed and can mean loss of control

To prevent this, the tail of the DC-8 has been designed to be effective at speeds well beyond the capability of the wing Like the wing, tail surfaces use specially designed airfoils Sweepback of both vertical and horizontal surfaces is 35 deg at 25% of chord and thickness ratios are only 9 5%

Interrelationship of fuselage shape and tail surface location has been carefully considered to put the surfaces in

Douglas DC-8 Basic Data

AREAS, DIMENSIONS

Wing	
Span	139.7 ft.
Area	2,758 2 sq ft
Mean Aerodynamic Chord (MAC)	266 in
Aspect ratio	7.1
Taper ratio	0 244
Dihedral (at trailing edge)	6.5 deg
Sweepback (25% chord line)	30 deg
Aileron span (each side)	24 ft.
Aileron chord (% wing chord)	24%
Flap span (each side)	405.7 in
Flap chord (% wing chord)	30%
Flap area	456.9 sq ft
Fuselage	
Maximum cross section (external)	
Height	162 5 in
Width	147 in
Length	146.3 ft
Static ground angle (nose down)	1 deg
Tail (horizontal surfaces)	
Span	47 ft 6 in
Area	559 1 sq ft
Aspect ratio	4
Taper ratio	0 329
Sweepback (25% chord line)	35 deg
Incidence (variable)	−10 deg to +2 deg
Dihedral	10 deg.
Location of elevator hinge line (% chord)	75%
Distance from 25% wing MAC to 25% horizontal tail MAC	813 4 in
Tail (vertical surfaces)	
Span	25 ft. 11 in.
Area	351.7 sq ft.
Aspect ratio	1.9
Taper ratio	0.299
Sweepback (25% chord line)	35 deg
Location of rudder hinge line (% chord)	65%
Distance from 25% wing MAC to 25% vertical tail MAC	750.8 in
Landing Gear	
Tread of main wheels	250 in
Wheel base	689.9 in.
Vertical travel of axle from extended to fully compressed strut positions—main wheels	16.5 in
—nose wheels	16 in
Clearance Dimension	
Height over tail	42.3 ft
Length (maximum)	150.5 ft.
Ground angle	13.2 deg

the low speed flow of the pressure recovery region behind the tapering fuselage tail section. Purpose of this is to hold local Mach numbers on the tail below free stream value. Horizontal stabilizer is staggered as far aft of the vertical fin as possible to prevent longitudinal positions of maximum velocities on the two surfaces from coinciding.

If this were not done interference between the two flows would raise the maximum local Mach number in each. Effect of these measures is to cut Mach number at the tail to .03 less than free stream value. The airplane will be tested up to Mach .96, which is .01 beyond the maximum dive figure. Tail characteristics are expected to show little compressibility effect at this speed.

Rudder and elevator hinge lines are aft of the positions where a shock could form to minimize change in hinge moments. Elevator hinge line is at 75% chord and the rudder hinge line is at 65%. The small chord elevator is made possible by the use of an adjustable stabilizer. Elevator action is manually controlled with an assist from a conventional aerodynamic tab boost system.

Possibility of tuck-under at speeds above Mach .9 is negligible but on the principle that conservatism is justifiable in a new airplane, Douglas has installed an automatic pitch trim compensator to counter nose-down trim change at transonic speeds. It compares a plotted local Mach number curve against actual local Mach number as measured by a highly sensitive Mach meter and puts out a corrective trim signal to adjust stabilizer position.

Rudder is hydraulically powered to make possible a maximum deflection of 30 deg. which is 50% greater than that attainable with an aerodynamic boost system. An interlock cuts maximum rudder deflection to 14 deg. when flaps are up. Manual back-stop system is capable of 20 deg. when hydraulic power fails.

Douglas engineers decided large rudder deflections were necessary to improve the inherently poor cross-wind landing characteristics of swept wing airplanes. Dihedral effect of swept wings at high angles of attack makes airplane over stable and a powerful rudder is needed to give sideslip angles necessary for proper cross-wind correction. A conservative estimate sets maximum allowable cross-wind for the DC-8 with powered rudder at 30 mph. Flight test may show that the DC-8 can be landed in a crab of as much as 6 deg., in which case the power system might be removed. Many people have worried about the likelihood of scraping a pod during a cross-wind landing with the up-wind wing low, but Douglas studies indicate it is no greater than the chance of striking a propeller against the ground in a DC-7C.

Hydraulic Stabilizer

Range of travel for center of gravity in the DC-8 is from 15% to 32% of mean aerodynamic chord. Longitudinal trim within this range is provided by a hydraulically driven adjustable stabilizer with an electrical standby drive. Both drives operate through a pair of screwjack actuators. The stabilizer moves at ½ deg. per sec. under hydraulic power and 1/20-deg. per sec. with electric power. Electric standby drive also is used in the auto-trim system of the autopilot.

Possibility of a runaway trim system has been eliminated by the use of a double valve system in series in the hydraulic loop and a similar technique in the electrical circuitry. If the drive chain of one actuator fails, the other actuator will stall before structural yield loads are reached. The screw jacks are irreversible and the stabilizer remains in the position at which the failure occurs. Elevator is powerful enough to land the airplane with the stabilizer jammed in the most unfavorable position, though it may be necessary to come in at a slightly higher speed than normal if trim is for a very high speed.

Longitudinal stabilizing forces are about the same as those for the DC-7C. Maximum elevator control force required to land the airplane with the CG at the forward limit is no more than 50 lb. Maneuvering forces are designed to range from 30 lb. to 65 lb. per 1G increment of load factor. As with other jet aircraft, the aft CG limit is set by the minimum acceptable maneuvering force rather than by the basic stability. Douglas has learned from experience with other airplane-autopilot systems that the acceptable ratio of maximum force per G (center of gravity forward) to minimum force per G, (center of gravity aft) should not exceed 2.5 or 3. If ratios are larger the autopilot usually lacks the power needed to fly the airplane properly when CG is forward if autopilot power is restricted to a safe level for flight with the CG aft.

Thorough wind tunnel studies of pitching moment, in which the DC-8 was compared with the B-66, indicate that DC-8 lacks the pitchup characteristics common in earlier swept wing airplanes. The DC-8 pitching moment curve at cruise Mach number is almost

Northrop N-156F in Mockup Stage

Mockup of Northrop N-156F fighter is refinement of Northrop Aircraft Inc.'s basic T-38 supersonic trainer. Fighter version will have boundary layer control on load-actuated leading edge slats. Range will be more than 1,700 naut. mi. with external tanks (AW Feb. 3, p. 34). Plane is designed to carry air-to-air or air-to-ground missiles. N-156F is 600 lb. heavier than T-38 trainer and is 1½ ft. shorter. Drogue chute will be used to shorten landing run. Company said N-156F is designed specifically to meet requirements of SEATO and NATO nations

linear and resembles the pitching moment curve of straight wing designs more than that of the swept wing bomber

Most DC-8s now on order will be powered by the Pratt & Whitney JT-4 (J75) and many overwater craft will be powered by the Rolls-Royce Conway. First airplane will fly with the proven Pratt & Whitney JT-3 (J57) Second will have the JT-4 First JT-4 powered DC-8 will be delivered to Pan American Airlines in December, 1959, and the first with Conways will be delivered in February, 1960

Powerplant installation has rated special attention in this first generation of commercial jet aircraft Engines have always been designed for military applications and later converted to civilian uses, but this is the first time civilian operators have ever had to cope with principles of operation fundamentally different than those of engines already in service Need for extreme care in designing the installation arises from the fact that in commercial use an engine must get along on much less maintenance attention than in military service Overhaul cycles may be as much as four times as long Military aircraft receive much rougher usage than commercial aircraft but the safe record of civil aviation in the past can be attributed largely to the success of manufacturers in designing protection against catastrophic failures into their airplanes

Much of DC-8 engine installation design was based on incident and crash report from airline government and military sources about troubles with various powerplants in service

Reliability Factor

In the engines and in all of the airplane's systems the DC-8 has been so designed that a single failure seldom if ever need ground the airplane The operation of each engine is independent of the operation of any other engine or any subsidiary system For the sake of reliability, all valve controls are cable operated

Three types of fire protection have been included Fuel may be shut off internal spaces are sealed off from any air supply, and a CO_2 extinguisher system is provided for each engine Fuel and sources of ignition such as hot surfaces and wiring are carefully segregated No combustibles enter the hot aft section of the engine pod except for a relatively small flow of lubricating oil Firewalls are installed at the upper and lower ends of each engine pylon To prevent the spread of fire within the pod there also is a firewall in the engine annulus at the front of the compressor section and a secondary fire seal between the turbine and compressor sections All materials in the hot zones are fire proof There is a bromotri-

fluoromethane fire extinguisher system in each wing and each serves two engines. The two extinguisher systems weigh less than a single central system.

Pod itself is no more than a fairing for the engine and its plumbing. It bears no important structural loads. Engine is suspended from three mount points, two forward and one aft. All thrust and inertial loads are taken out through these points to the pylons.

Basic difference between intercontinental and domestic versions of the DC-8 is the amount of fuel carried although each has an eight tank primary system. Overwater system has a center section auxiliary tank which replenishes all the primary tanks automatically. Douglas engineers concluded that automatic refilling of the primary tanks is necessary because the relative difficulty of restarting turbojets makes fuel interruption a more serious occurrence. Four main and four alternate tanks of the primary system constitute a separate system for each engine. Fuel can be cross fed if the pilot deems it necessary, but Douglas engineers call it an undesirable practice because of possible fire hazard when large quantities of fuel are moved.

Tanks are pressure fueled through a pair of underwing fill points between the pylons and near the leading edge on each wing. With present ground equipment, fuel can be put aboard at a rate of about 1,000 gpm. using all four fill points at once. The system is capable of handling 1,400 gpm. High fueling rate is intended to cut turnaround time. Dual float fill valves close automatically when tank is full. Vent manifold tying the tanks together and leading to the overboard drain has been made unusually large. Manifold collects any overfill and drains it into an emptier tank if one is available. If not, the manifold carries the excess fuel out the wingtip vents.

Fire started by static discharges during fueling has become a bigger problem with the advent of jets. Static charge is built by friction between fuel and line and by shearing within the fuel. Danger has been increased by higher flow rates and the use in jets of heavier, more viscous fuels. Douglas has countered the threat by locating the filler screen close to the bottom of the tank so that rising fuel closes the possible spark gap early in the fueling process before the charge becomes dangerous.

Fuel is supplied to each engine by two fuel pumps, an engine-driven suction pump in the nacelle and an electric pump in the fuel tank. Hot oil is shunted from the constant speed drive for each engine-driven electrical generator through an oil-fuel heat exchanger to prevent fuel filter icing. Oil is not valved into the exchanger until fuel temperature drops near the freezing point of water raising the possibility of ice collection in the filter.

Mobile starting equipment can be used on any of the four engines. When the first is running, the other three may be started with cross-bleed from the aircraft pneumatic system. Douglas is offering a line combustor unit in the No. 3 nacelle as an optional installation for customers who need a self-contained starting system. Bottled air supply at 45 psi. in the wing is automatically recharged in flight by a hydraulic motor compressor. Combustor burns engine fuel and is supplied a 50-50 water-alcohol mixture for power augmentation and flow cooling.

Water Injection

Airplanes powered by the JT3 have four separate engine-driven powerplant water injection systems with four 190 gal. supply tanks. The tanks are pressurized to ensure a priming flow at starting. JT4 and Conway versions do not use water injection.

Each engine has its own lubricating oil system with a supply tank mounted in the nacelle. Tank is divided in two sections, one for engine oil and the other for constant-speed drive oil. Separation prevents line failure in the drive system from draining off engine oil and eliminates possibility of one system contaminating the other. Tank capacities are 6.8 gal. for the Conway, 10.7 gal. for the JT3 and 12 gal. for the JT4. An air ejector keeps air flowing through the oil cooler when an engine is running on the ground.

DC-8 combination thrust reverser-noise suppressor grew out of 4,500 separate test runs of nearly 600 suppressor designs and six combinations which were required to occupy no more space than the suppressor alone.

Douglas suppressor consists of a "daisy petal" lobe flow tailpipe and a retractable ejector. Lobe flow gives exhaust jet cross section a longer perimeter and greater contact area per axial foot with outside air. In this way energy is dissipated sooner and closer to the tailpipe exit. Since exhaust expands downstream forming a conical surface of contact with outside air early dissipation of energy reduces the area in which sound is radiated.

Ejector is a simple shroud which encases the exhaust jet, leaving a gap of several inches between shroud and the tailpipe exit through which outside air is entrained. This reduces exhaust velocity and increases its mass. Mass flow rate and thrust are effected slightly, but lower velocity means less shear and less energy dissipated as noise.

Since entrained air is heated by exhaust gases in the ejector, it acts something like a bypass or afterburner and produces a small net increase in static thrust at beginning of takeoff run. As speed and drag increase, ejector advantage decreases until at 100 kt., thrust is about equal to that of a smooth unsuppressed nozzle. At 150 kt., ejector effect has disappeared and thrust equals that of an unaided daisy petal nozzle. As speed continues to increase, drag of the ejector rises more rapidly than thrust increment and it is retracted to minimize this.

Since the daisy petal tailpipe shortens the sound generating region a good proportion of the most intense noise is walled off by the ejector shroud. Total sound reduction of the suppressor is 13.5 db., of which 3 to 5 db. are credited to the ejector. With the daisy petal nozzle alone average intensity throughout the noise frequency band is lowered but at high frequencies it is increased. With the ejector and daisy petal combined distribution of intensity with frequency has two peaks at opposite ends of the frequency scale, both of which are lower than unsuppressed levels. Average figure for the noise suppressed DC-8 is about 3 db. below the average produced by propeller-driven four engine transports.

Douglas reverser is a conventional clamshell design producing reverse thrust equal to 40% of forward thrust.

Trim change is of the same order as that caused by extension of the flaps. Its primary cause is not the pitch up moment exerted by the reverse thrust but a change in the pattern of air flow over the wing due to circulation of the reversed jet blast.

(This is the first of two articles on the Douglas DC-8. The second will appear in next week's issue.)

Soviet Oxygen Mask

Russia has developed a cheap, plastic, throw-away oxygen mask for passengers on Aeroflot's jet and turboprop transports. Mask which is discarded after one-time use, is said to meet all hygiene requirements.

How Research Shapes Our Future Prosperity

If you are looking for an industry that is going to keep on booming in 1958 and every year for the next decade, here it is. It is the industry of technological innovation through research and development.

Last year this great new industry spent over $7 billion to discover and develop new industrial products, processes and equipment. This year the preliminary McGraw-Hill survey indicates that total expenditures for industrial research and development will be even greater, perhaps as much as $8 billion. Of the companies surveyed, 57% plan to spend as much as in 1957 and 38% plan to spend more.

The sustained expansion in research and development is the best guarantee we have that the current decline in business investment in new plants and equipment will be relatively short-lived. There can be no prolonged decline in investment in an economy where technology is changing rapidly.

This editorial is designed to show how the continued surge in research and development can be expected to lead first to new products, and eventually to renewed expansion of investment in new industrial plants and equipment. Such expansion is the essence of national economic growth.

A Slow Start

The impact of research on sales and investment is still very gradual. Research spending itself has more than doubled in the last four years. But only 32% of all manufacturing firms report significant capital outlays to make new products. We are not reaping the full dividends of industrial research as yet for several reasons:

- Research expenditures were relatively small until the Korean War of 1950 brought substantial government contracts in aviation, electronic and related fields. Heavy research outlays for civilian and industrial products came even later.

- There is an average *lag*, according to research directors consulted by the McGraw-Hill Department of Economics, of roughly seven years from the start of research until the product is ready for large scale output — about five years of research and at least two years to solve production problems and develop markets.

- Complex products, such as new consumer durables and industrial machinery, have an even longer time lag.

However, new developments are certainly underway. Research began to increase in all lines of business when Korean War restrictions and the excess profits tax came to an end in 1953. The tax revision of 1954 added a new incentive by making research outlays deductible as a current business expense. By 1955, the research boom was on.

When Is The Payoff?

With a lag of about seven years, it will be the early 1960s before these new developments become a dominant factor in capital investment. But once the flow of new products and new processes starts, it will accelerate sharply — just as research spending has accelerated in the past few years.

By 1960, over $50 billion in sales will be coming from products not on the market as recently as 1956. Sales of new products will increase year by year, but they will gain most in 1960-1962, or five years after the recent spurt in research expenditures.

Capital expenditures to manufacture new products will also rise, but with a slightly longer lag. Here the sharpest rise should come in 1962-1965, as the new products reach a volume that calls for a significant amount of new capacity. In most cases, initial output of new products will come from existing capacity.

This timing of a new wave in capital investment appears logical on other grounds. Population experts forecast an upsurge in marriages and births around 1965. So by 1962, industry will be starting to tool up for new mass markets.

The important point is this: As we approach the 1960s more and more sales and investment will be in new products growing out of research. By 1960 well over 10% of manufacturing sales will be in new products not on the market in 1956.

Meanwhile — research will help stabilize capital spending by raising the level of modernization and replacement expenditures. Of course, research does not eliminate all the ups and downs in the demand for capital goods, for there remain variations in the amount spent to expand capacity. But a high level of modernization, to cut costs and improve quality, does put a floor under any drop in investment.

What To Expect

During the next few years we can expect an increasing flow of new materials, new metallic alloys, new machinery — primarily those developments coming out of long-established research programs in the chemical and electrical industries. Industry will make wider use of specialized computers and automated equipment.

But the dramatic payoff on research comes even later. In the early 1960s the consumer goods industries will begin tooling up for their really new products — things so basically new they can change the way a family lives. Such items as plastic houses, paper apparel, turbine autos are under development right now. But it will take several years to get costs down and for population and incomes to grow to the point where mass markets are created.

When we reach that point in the mid-1960s, there will begin the greatest surge of capital investment in all history. And then — around 1965 — the new processes (full automation, atomic power, continuous steel casting) which are the slowest and most expensive part of the research chain to develop, will come into play.

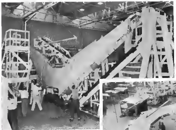
The combined impact of new products and new processes, to meet an expanding market, will thus be felt in the mid-1960s — eight to ten years after the recent sharp increase in research spending. The full impact is that far away because of the lags for applied research, pilot plant studies and market introduction. But to a large degree the prosperity of the 1960s has already been shaped by the research programs now underway.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

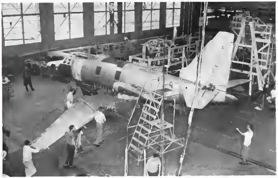
Donald C McGraw
PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

UTX Sabreliner Wing, Fuselage Joined Together



North American Aviation's UTX Sabreliner utility trainer is expected to roll out at the end of May. Flight date is set for July 30, subject to delivery of General Electric J85 turbine engines. Aircraft will be tested at Palmdale, Calif. Above and at right wing is removed from jig, lowered to tripod support jacks for mating with the fuselage.



Sabreliner fuselage is being mated with wing. Fuselage is raised by sling, moved into position over wing center section, then lowered onto wing for joining to center section. Nacelles (without engines) are supported on horizontal pylons extending from aft fuselage sides.

Tests Predict Avionics Field Failures

By Philip J. Klass

New York—New component failure rate data obtained from more than one million hours of tests on over 50,000 avionic equipments now makes it possible for Collins Radio Co. to accurately predict failure of its equipment in field use.

Using component failure rate data gathered in 2½ yr. of factory testing, Collins' estimated mean time between failure for two types of airborne equipment checked within 15% of the actual field use experience for two types of airborne avionic equipment, R. L. Vander Hamm reported during Institute of Radio Engineers convention here.

- **High frequency communications** transceiver, used by both airlines and military, experienced a mean time between failure of 700 hr., compared to predicted figure of 610 hr.
- **Complex military transceiver,** with predicted time between failures of 95 hr., actually showed 86 hr. between failures in field use.

Accurate prediction of equipment reliability in the past has been difficult because of wide discrepancies between published figures on component failure rates, each obtained from different sources under different conditions, Vander Hamm said. For instance, vacuum tube failure rates per 1,000 hr. use have been reported at between 5% and 25%, resistors between 0.04% and 1.5%, capacitors between 0.08% and 2.4%, Vander Hamm noted.

If designer uses most pessimistic figures for predicting mean life to failure he might come up with a figure of "X" hours, whereas a figure of "20X" is obtained by using the most optimistic failure rate data previously available.

Note of Caution

Vander Hamm cautions, however, that the Collins component failure rate data cannot be used indiscriminately by other avionics manufacturers because of possible differences between company design practices, quality control procedures, reliability techniques and other intangibles. For example, Collins employs a minimum component derating factor of two, whereas some companies may use larger, smaller, or no derating.

With this note of caution, Vander Hamm presented the following figures on component failure rates per 1,000 hr. operation:

- Vacuum tubes: 3.4%.
- Motors, dynamotors: 2.3%.
- Switches: 0.7%.
- Relays: 0.5%.
- Diodes: 0.45%.
- Transformers, inductors: 0.4%.
- R. F. Coils: 0.15%.
- Connectors: 0.07%.
- Capacitors: 0.63%.
- Resistors: 0.0089%.

Test Details

Data are based on special reliability tests conducted on every piece of equipment produced at Collins' main plant in Cedar Rapids during past 2½ yr. These tests were run following regular production line inspection/performance tests during which equipment might be operated anywhere between 2 hr. and 40 hr.

Reliability tests consisted first of a five-minute exposure to 2G vibration at 30 cps., followed by 20 hr. of power-on operation which included mechanical cycling and keying to simulate actual field operation.

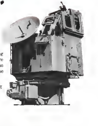
"Infant mortality" type failures—those occurring during normal factory testing—were intentionally excluded from the Collins component failure rate data inasmuch as these usually are weeded out before equipment reaches the field.

In order to obtain data which reflect random failures in the field, Collins also

Component Part Failure Rates

(Derived From Equipment 20-hr. Reliability Tests)

TYPE AND SUB TYPE	Total Operating Hours × 10³	Total Failures	Failure Rate %/1,000 Hours
Capacitors			
Electrolytic, Aluminum, Commercial	450	2	0.44
Electrolytic, MIL-C-62, MIL-C-3965	3,400	7	0.21
Mica, Silvered Button, MIL-C-10950	41,000	12	0.029
Mica, Silvered, MIL-C-5	5,400	8	0.15
Mica Foil, MIL-C-5	660	0	
Ceramic, HiK, MIL-C-11015	37,000	18	0.049
Ceramic, JAN-C-20	20,000	13	0.065
Ceramic, Variable, MIL-C-81	11,000	2	0.018
Paper, MIL-C-25	1,360	2	0.14
Paper, Better than MIL-C-25	38,000	35	0.09
Air, Variable, Transmitting	170	0	
Air, Trimmers, JAN-C-92	2,100	1	0.047
Total (Capacitors)	160,540	100	0.063
Resistors			
Wirewound, Fixed, Low Power, JAN-R-184	680	0	
Wirewound, Fixed, High Power, JAN-R-26	5,900	1	0.017
Wirewound, Fixed, Precision, MIL-R-93	360	0	
Composition, Variable, MIL-R-94	3,300	5	0.15
Composition, Fixed, MIL-R-11	98,000	4	0.0041
Film, Fixed, MIL-R-10509	2,000	0	
Total (Resistors)	110,240	10	0.0089
Vacuum Tubes	19,000	650	3.4
Transformers, Inductors, Filters	5,000	20	0.4
Switches	10,000	70	0.7
Motors, Dynamotors	2,600	60	2.3
Connectors	10,000	7	0.07
R. F. Coils	13,000	20	0.15
Diodes	2,200	10	0.45
Relays	7,000	35	0.50



excluded component failures due to faulty design or manufacturing techniques.

Every component failure was analyzed, placed in one of three following categories:

- **Manufacturing assembly error**—such as cold solder joints, pinched leads or improper adjustment—34%.
- **Design deficiency**—such as exceeding safe component rating or poor mechanical design—12%.
- **Components themselves**—not a result of other two factors—54%.

Only the failures in this late category were used in computing component failure rates—and not all of these were included.

Bad-Batch Failures

Where component failures were of an epidemic or bad-batch nature, or where there were large numbers of the same component failures because of time required to obtain and introduce an improved quality replacement, these failures also were excluded.

As a result, the component failures which were used in computing failure rates represent, Collins believes, the random failures which can be expected in service in a well-designed, well-constructed piece of avionic equipment.

At first glance it might appear that the Collins data are not valid because of the totally different environments at the factory and in the field, Vander Hamm admits.

MORE than one million hours of reliability testing, accumulated on over 50,000 individual avionic equipments during 2½ yrs., has provided new component failure rate data which enables Collins Radio Co. to accurately predict reliability of equipment in field use.

Predicting Field Reliability

However, by proper application of components with deratings which take account of field environment, Vander Hamm believes that factory test data are applicable to predicting field reliability.

This appears to have been substantiated by two airborne equipment comparisons cited.

It might also be argued that a collection of data based on many equipments operated for 20 hr. periods is not representative of failure rates encountered in a single equipment over a long period of usage. However, Collins subjected 500 equipments to 50 hr. tests and another batch of 15 to tests ranging from 200 to 750 hr. There was no significant difference in component

failure rates between these two special tests and the regular 20-hr. test data, Vander Hamm says.

Collins is, however, continuing its reliability testing program and plans to re-evaluate all data in another year. Another check on the validity of the data should be possible late this year or early in 1959. Under cognizance of Aeronautical Radio Inc. (Arinc) program is underway to compare the component failure rates in a number of military AN/ARC-52 ultra-high frequency transceivers operated both in long-term bench tests and in field use under careful surveillance to obtain reliable information.

FILTER CENTER

▶ **Small Wonder**—Airborne digital computer being developed by Litton Industries for use in Navy airborne early warning (AEW) aircraft will use 40,000 diodes and 10,000 transistors, which partially explains rising sales of semiconductor industry.

▶ **Good News**—Increased funds for basic research and development in components, perhaps as much as $10 million over present levels, will be authorized by Defense Department shortly. Move is intended to improve component reliability. Funds will be spent by three military services, supplementing their existing programs.

▶ **Doppler Navigator**—Collins Radio Co. expects to flight test first model of its transistorized Doppler ground-speed/wind drift indicator late this year, hopes to have prototypes of the 65 lb. system available for airline evaluation early in 1959. Production models are slated to be available late in 1959. Collins will use FM/CW system, employing Janus (three beam) technique operating in X-band (8,800 mc.). Overall accuracy (including indicator errors) is expected to be within 3 kt. ±0.6% for ground speed, ±1 deg. for drift angle.

▶ **No ATA Decision on DME**—Airlines are holding back on an official industry decision to make fleetwide purchases of Tacan compatible DME pending results of airline evaluations of DME-T and of Doppler into navigators which some observers believe will eliminate need for DME-T. United, American and Northwest are among the airlines expected to participate in the evaluation.

▶ **Easy Money**—East Coast Conference on Aeronautical and Navigational Electronics, to be held Oct. 27-28 in Baltimore, will award two prizes, $100 and $50, for the two best technical papers submitted. To be eligible, papers must be received by Sept. 1 with 500-word abstracts with brief professional record of the author by May 15. Write to W. A. Scanga, Technical Program Chairman, Aircraft Armaments, Inc., Cockeysville, Md.

▶ **"Poor Man's" DME**—New type of distance measuring equipment which requires only small adapter to enable VOR or VHF communications receiver to give pilot his distance from a similarly equipped ground VOR or VHF station has been developed by Bendix Radio Division of Bendix Aviation Corp. Accuracy is quoted as within one to two miles at ranges of 100 mi. Airborne interrogator (adapter) provides an 800-cycle tone modulation of airborne transmitter which is transmitted for one quarter second, causing ground station to reply with similar tone modulation with identical phase to received signal. Airborne unit compares phase of transmitted and received signals to compute distance to ground station. Present airborne DME adapter weighs 5 lb., measures 7 x 6½ x 10½ in., but this could be reduced by 50% in production, Bendix estimates. Company is not pushing technique for civil use as alternate to Vortac DME, but plans to demonstrate equipment to interested civil and military agencies.

Aeroquip Makes Titan Hose Joints, Nuclear-Powered Aircraft Valves

Jackson, Mich—Aeroquip Corp is expanding and diversifying with new products and techniques to keep pace with developments in the fields of jet engines ballistic missiles and nuclear powered aircraft

While still devoting considerable time and energy to refining its staple product—a wide line of medium and high pressure, high temperature flexible aircraft hose, associated fittings and couplings—Aeroquip and its divisions are embarking on several new endeavors, some of which are totally unrelated to flexible aircraft hose.

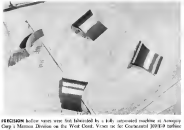
Product Developments

Latest product developments at Aeroquip and its divisions include:

- **For jet engines** precision hollow vane and stator assemblies that are formed, welded and inspected in a fully automated machine which turns out constant section blades at company's Marman Division on the West Coast Company contemplates being able to make blades with twisted sections and tapered walls by putting them through additional processes
- **For ballistic missiles** 6,000 psi operating, 24,000 psi. burst pressure Teflon hose and reusable fittings for servicing pneumatic systems on missiles (Previous maximum operating pressure for flexible hose was in the 3,000 psi range). Marman-made Conoseal wide temperature range high pressure (up to 6,000 psi) all-metal tubing joints are used on many missiles and entirely on the Martin Titan, according to the manufacturer
- **For nuclear-powered aircraft** oversize check valves, 18 in in diameter which weigh 350 lb and 400 lb. respectively, have been produced for General Electric's Aircraft Nuclear Propulsion Division Units are enlarged versions of the Marman in-line check valve used on many of today's aircraft and jet engines Valves incorporate poppets which weigh 90 lb and whose movement is damped by specially designed shock absorbers and an 18 in diameter, metal to metal lap finished seat Each valve will handle a flow of 2,700 lb of air per minute and will withstand a pressure of 250 psig

Aeroquip says that the Marman check valves will be installed initially in an atomic reactor used in a test propulsion unit driving a railway flatcar When the check valves have successfully passed their operating tests, they will be used in an atomic engine designed to power a nuclear aircraft Conoseals also are going into General Electric's atomic engine

Aeroquip's Marman Division developed a new automatic forming and welding technique to manufacture precision hollow vane and stator assemblies for gas turbine engines To date,



PRECISION hollow vanes were first fabricated by a fully automated machine at Aeroquip Corp's Marman Division on the West Coast. Vanes are for Continental J69-T-9 turbine engine.

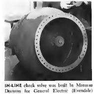
some 200 blades have been furnished to Continental Aviation & Engineering Corp. for tests as turbine star stators on the company's J69-T-9 and J69-T-19 powerplants.

Continental research officials told AVIATION WEEK that "our interest in the blades is high, although our experience with the units to date is not sufficient to make a fair evaluation."

The 60 ft. long machine cost $250,000, requires a single operator plus a helper who feeds in stock and performs other operations as required.

Sheet or coil stock is automatically fed into the machine which forms, welds and inspects continuous lengths of precision made blades by passing the metal through 30 transfer stations. Vane surfaces are scanned by electronic instruments during the manufacturing process to hold surface tolerances to .007 in.

Aeroquip says that a new welding process it developed and which is used by the machine produces a continuous homogeneous weld nugget ⅛ in. wide to make the hollow vane as structurally sound as a drawn tube.



IN-LINE check valve was built by Marman Division for General Electric (Evendale) Atomic Propulsion Division. Internal duct size is 18 in. All-stainless unit weighs 400 lb. These over-size units are enlarged versions of the Marman in-line check valve used on many of today's aircraft and jet engines. Valves have poppets which weigh 90 lb.

Evaporation Slow In Oxygen Converter

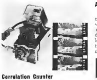
Liquid oxygen converter for aircrew use is warranted against excessive evaporation loss by its maker, the Linde Co., Division of Union Carbide Corp.

The five-liter converter carries a one year warranty assuring against a loss of more than 2½ lb. per 24 hr. period. Container consists of two concentric shells with annular space under powder vacuum. The 9 lb. unit supplies enough oxygen to sustain one man above 35,000 ft. for 24 hr. It will supply 10 men for 2½ hr., or any proportion in between. Operating at pressures of 70 psi., the converter delivers up to 150 liters of oxygen per min.

Consisting of two concentric shells with the annular space under powder vacuum, the unit meets specifications of MIL-C-25672 (USAF) requirements at ambient temperatures of −65 to +2601

FIVE-LITER liquid oxygen converter can supply 24 hr. of gaseous oxygen for one aircrew member. Converter, manufactured by Linde Co. Division of Union Carbide Corp., can deliver up to 150 liters of gaseous oxygen per min. Lightweight units weigh about 9 lb. Vacuum of the oxygen converter is checked by mass spectrometer. Container consists of two concentric shells with annular space under powder vacuum.

NEW AVIATION PRODUCTS



Correlation Counter

Mechanical counter for instrumentation cameras provides a simple method of correlating events recorded by two or more cameras or other instrumentation, eliminating need for pulse lighting, the maker states.

Model 652 correlation counter is used in photographic instrumentation cameras for missiles and aircraft, as well as in various industrial and military evaluations.

Mounted on a bracket attached to the camera, the counter displays lighted numbers in front of the shutter which are recorded on the edge of the film frame.

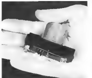
By simultaneously actuating counters mounted on several cameras or instruments, the user obtains positive correlation.

A common number appears on frames which are related in time.

Trad Corp., Encino, Calif.

Acceleration Switch

Low cost single-post single throw acceleration switch with omni-directional sensitivity in a single plane and adjustable acceleration setting now is in production. When preset acceleration level is reached in the plane of sensitivity, the switch trips and locks in a closed position regardless of subsequent



accelerations. A reset button returns switch to open position.

Manufacturer says Model 117's small size and weight make it useful for emergency exit lighting, destruction of classified equipment and actuation of automatic fire fighting equipment.

Features of the device include 2 amp. d.c. resistive load contacts, a minimum life of 10,000 operations, acceleration setting range of 1.5 to 5.0G with a setting accuracy of ±0.25G, temperature range of −50 to 130F, and immunity to vibration of 5 to 500 cps. at 5G.

Mason Instruments Corp., Long Island City, New York.

Pneumatic System Valve

Valve for pneumatic systems developed for Britain's Comet IV airliner is a hot air electro-pneumatic stop valve with a thermal range from minus 40C ambient to plus 365F.

Type MD 32 can be kept continuously energized at the highest temperatures. Rated at 24 v., it consumes 0.61 amp. at 20C. When the solenoid is energized, air from upstream side of the valve passes through pilot valve to rear piston of a larger area than the valve poppet, thus opening valve. It is closed by shutting off flow of upstream air to the piston. Residual air bleeds past piston clearance to spring chamber, which is vented to atmosphere. Valve is normally used for pressures up to 150 psi. It can be used as flow-controlling orifice in its own position with a pressure drop of 7 psi. at 5 lb./min. flow.

Applications include control of compressor-bled air for wing de-icing and emergency fuel jettisoning, hot air pneumatic systems, airborne guided weapons and boundary layer control.

Hymatic Engineering Co., Redditch, Worcestershire, England.

Unit Moves Jetliner Wheels

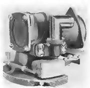
Mobile power vehicle of wheel-mover system developed by Consolidated Diesel Electric Corp. is parked beneath wing of Boeing 707 jetliner at start of Seattle, Wash., test flights. Hydraulic gear transmits torque power to 707 wheel rim to propel aircraft on ground. Note jet engine noise suppressor at right.

Pressure Transducer

Cavity type pressure transducer utilizes the unbonded strain wire principle for measuring pressure under extreme environmental conditions. Designed for measurements of fluctuating or steady state pressures in liquids or gases, the instruments are used for measurements in hydraulic and pneumatic lines in missiles and aircraft. Water depth determinations, bottom of oil wells, gas and oil pipelines and the monitoring of chemical and petroleum vessels are other applications.

Glennite PSG-1 Series pressure transducers are supplied in ranges of 25, 40, 100, 150, 200, 250 and 300 psi for performance in temperatures from −100F to +300F. Constructed of Monel housing and stainless steel cavity, fluids can be used as a pressure media only if they are non-corrosive to type 417 stainless steel.

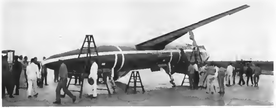
Gulton Industries, Inc., 212 Durham Ave., Metuchen, N. J.



Fuel Tank Valve

Fuel valve prevents pressurizing air from being drawn from fuel tank by closing the tank outlet before the fuel level falls below the valve inlet. Fuel cannot return to tank. Unit is insensitive to accelerations and fuel contamination, the maker states. Thin wall aluminum castings reduce weight, and ceramics are used to withstand extreme temperature variations. Valve meets requirements of MIL-E-5272a.

Sales Engineering Dept., Aero Supply Mfg. Co., Corry, Pa.



Snark Lands on Skids With Little Damage

Post landing photographs of Northrop Snark missile show that its recovery system of two Y-shaped skids retractable into fuselage together with skids at wing tips make for a chase-plane controlled landing with little damage. This indicates good lateral control during recovery. Two doors open outward and one swings aft to allow skid to drop (top). Right wing rests on its tip skid. Note drag chute at rear. Recovered Snark (below) is hoisted for removal to Northrop hangar.

Telling the Market

Description of platinum-clad metals, Technical Data Bulletin PLA 5, General Plate Division, Metals & Controls Corp., Attleboro, Mass. . . . Bulletin No. 341 explains how the technique of resistance welding is adapted to the production process, Sciaky Bros., Inc., 4915 West 67th St., Chicago, Ill. . . . Description of the performance and specifications of the Kth 57 cine theodolite for ballistic and missile photography, brochure, Perkin-Elmer Corp., Norwalk, Conn.

Construction details, photographs and description of Eccosorb Anechoic chambers for VHF, UHF and microwave free-space rooms, brochure, Emerson & Cuming, Inc., 869 Washington St., Canton, Mass. . . . Dimensional drawings, assembly procedures and tooling information on one-piece and two-piece compression sheath connectors for shielded or coaxial cable, catalog, Omaton Division, Burndy Corp., Norwalk, Conn.

Diffusion Process Makes Plain Carbon Sheet Stainless, illustrated bulletin, Chromalloy Corp., 450 Tarrytown Rd., White Plains, N. Y. . . . Catalog No. 500 describing company's expanded facilities for engineering and manufacturing rigid tubing components, Advertising Dept., Aeroquip Corp., Jackson, Mich. . . . Construction specifications and operating characteristics of Romulus Tool and Engineering Co.'s milling spindles, catalog No. R1-58, Denham & Co., 925 Book Bldg., Detroit 26, Mich.

Configurations of Exit Taxiways From Runways, Research Report No. 25, Institute of Transportation and Traffic Engineering, University of California, Berkeley, Calif. . . . Information, photographs, flow diagrams and dimensional drawings of the Beckman Electrolytic Hygrometer, Bulletin E11-4001, Beckman Process Instruments Division, Fullerton, Calif.

Data Sheet No. 1273 covering details of the series 7600 precision potentiometer, and Data Sheet No. 1289 covering details of the self-contained 400-cycle expanded scale frequency meter, Helipot Technical Information Service, Helipot Corp., Newport Beach, Calif. . . . Applications, special features, dimensional code and torque conversion charts, etc. for miniature ball bearings, 1958 catalog, Miniature Precision Bearings, Inc., Keene, N. H.

Illustrated description of flat surface disc grinders, abrasive discs and cylinder wheels, Condensed General Catalog Gardner Machine Co., Dept 21, Beloit Wisc . . . **Packing handbook**, Bulletin No AD 162, details packings gaskets and seals and their materials of construction and uses, The Garlock Packing Co., 422 Main St., Palmyra N. Y.

Selcetalog, annotated directly of AMP technical catalogs, AMP Inc, Harrisburg, Pa . . . Descriptive and technical data on **Pyro-optical, micro-optical, radiation, immersion, surface and indicating pyrometers**, Catalog No 175, The Pyrometer Instrument Co Inc, Bergenfield, N J . . . Specifications and illustrations of **dial scales**, The Howe Scale Co., Rutland, Vt.

Technical details on a 200-frame-per-second 16mm camera for use in missile tracking, testing, and airborne flight data recording, "Gordent 200" literature, Gordon Enterprises 5362 North Cahuenga Blvd., North Hollywood, Calif . . . Buyers' guide to **hot rolled steel bars**, structurals, plates sheets and strip, technical bulletin No 11-2, Joseph T Ryerson & Son, Inc., Box 8000-A, Chicago 80, Ill.

Sylvania Electronic Systems for National Defense, brochure outlining the company's capabilities in electronic warfare systems defensive missile systems, radar countermeasures, etc., Sylvania Electric Products Inc. 100 First St., Waltham Mass . . . Physical properties specifications and details of **Servofrax® for infrared instruments** brochure FDS-4, Servo Corp of America, 2020 Jericho Turnpike, New Hyde Park, N Y.

Descriptions and illustrations of voltage regulated power supplies including transistorized, magnetic and vacuum tube types technical bulletin No B581, Kepco Laboratories Inc, 131-38 Sanford Ave., Flushing 55, N Y . . . Properties, uses applications and advantages of **magnesium alloys** and products, booklet, White Metal Rolling & Stamping Corp, 88 Moultrie St Brooklyn 22, N Y.

Electrical operating characteristics, performance curves, application data outline drawings dimensions and prices of more than **300 different types of microwave waveguide components, test equipment, and pressure windows**, Catalog 58CP Sales Department Microwave Associates Inc, Burlington Mass . . . Applications and summary of electrical properties of **Class 900 silicone rubber for wire and cable insulation**, bulletin, Silicone Products Department General Electric Co., Waterford N Y.

Specifications applications and description of **Model 103 total temperature probe**, Bulletin 15811, Rosemount Engineering Co., 9424 Lyndale Avenue So., Minneapolis 20, Minn. Design requirements for **anti-friction bearings** of unusual shapes and sizes Bulletin AFB-2, Industrial Tectonics Inc., Ann Arbor Mich. Applications and description of **Alina dial comparator set No 99**, Catalog D Alina Corp 122 East Second St Mineola N Y

Photographs, dimensional drawings, charts and description of **Beckman standard electromechanical breadboard parts**, Catalog 575, Helipot Corp division of Beckman Instruments Inc. New Port Beach, Calif. Applications and line drawings with dimensions of ways **Jones tachometers** may be installed in different applications, Booklet 58, Jones Motorola Corp 432 Fairfield Ave Stamford Conn

Description of high performance **photographic instrumentation cameras and accessories** and **scoring system** for use with missile target drones six page folder, Traid Corp 17136 Ventura Blvd., Encino Calif. Outline of services and facilities available for the **design, development and fabrication of models, mock-ups and prototypes** brochure, PDD Corp 379 Market St., East Paterson, N J

Publications Received:

Five Down and Glory—by Gene Gurney and edited by Mark P Friedlander, Jr—Pub. G P Putnam's Sons, 210 Madison Ave., New York 16, N. Y. $5.75

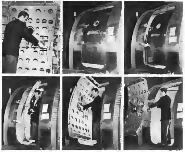
A history of American aces from the Lafayette Escadrille through the Korean War Contains detailed records on USAF fighter pilot kills in both World Wars and the Korean War Written in the hasty "gee-whiz" style of World War II Air Force press releases, poorly researched containing many factual errors, and contributes little new information on either USAF fighter pilots, their tactics or their enemies not already on the published record

Fatigue of Aircraft Structures—Pub American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa $2.75, 104pp

This book covers material of interest to metallurgists and mechanical engineers working with problems of fatigue

Plane Crash—by Clayton Knight—Pub Greenberg, 201 East 57th Street, New York 22, New York $4.50, 213 pp

Detailed reports of the mysteries of major air disasters taken from official documents of the Civil Aeronautics Board, and the F B I



Boeing 707 Door Tested

Cabin air pressure seals this plug-type door which will be installed on Boeing 707 jet transports when they enter service Door is higher than doorway, to open, door is reduced in height by folding upper and lower ends Designed by Boeing, door is undergoing tests which involve opening and closing at least 25,000 times.

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D C

High Temperature Protective Coatings for Magnesium—by C R Fitzgibbon L H Miller and M A. Glaser, Midland Industrial Finishes Co., for Wright Air Development Center, U. S. Air Force April, 1957 $3.00, 112 pp., (PB 131-073)

Methods of Accelerated Weather Deterioration for Fluorescent Paints—by F M Noonan and J E Cowling, Naval Research Laboratory November, 1957 $.75, 23 pp., (PB 131302)

Age-Hardening Characteristics of a Cast Alloy of Copper-Six Percent Titanium—by N Hehner, H McCurdy and R. Edelman, Frankford Arsenal, U. S. Army Ordnance Corps July, 1956 $.50, 16 pp., (PB 131297)

Organosilicon Compounds Part 2—The Cyclopentamethylenedialkylsilanes — by H Rosenberg, C Tamborski and M D Rausch, Wright Air Development Center U S Air Force $.50, 20 pp., (PB 131389)

Investigation into the Use of Heterocyclic Compounds as Lubricant Additives Part 2—by G B Butler, O L. Gordon and L A Haynes, Peninsular Chemresearch, Inc., for Wright Air Development Center, U S Air Force. February, 1956 $.50, 18 pp., (PB 131-223)

The Determination of Halogen in Gasoline—The Analyses of Organo-Halogen Compounds—by W D Garrett and J A Krynitsky, Naval Research Laboratory October, 1957 $.50, 16 pp., (PB 131327)

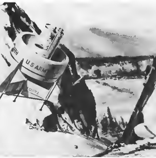
High Speed Tensile Data for Cellulose Acetate Butyrate—by R E Ely, Redstone Arsenal, U S Army July, 1956 $.75, 25 pp (PB 131242)

Tables of Thermodynamic Properties of Argon Free Air to 15,000 K—by J Hilsenrath and C W Beckett National Bureau of Standards for Air Research and Development Center, U S Air Force September, 1956 $1.25, 44pp., (PB 131276)

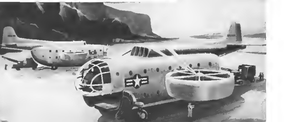
Porosity in Formed Titanium—R A Wood, D N Williams, H R Ogden and R I Jaffee Titanium Metallurgical Laboratory Battelle Memorial Institute, for the Office of Assistant Secretary and Defense for Research and Development May, 1957 $1.25, 42pp., (PB 121628).

Heavy lift helicopter design study employs rotortip mounted turbojets aimed at reducing complexity of big rotary wing aircraft.

Hiller Considering Several VTOL Configurations



Research into ducted propeller applications by Hiller Helicopters has centered on configuration ranging from rotortip-powered heavy helicopter (above) to coleopter-type platform (left) Rotor turbojet research probably will be intensified this year in move to reduce helicopter complexity, study fuel consumption Coleopter-type vehicle would have 70-80 mph. speed, could be capable of supersonic speeds in horizontal flight Another heavyweight helicopter configuration (bottom) is one of four designs, utilizes rotatable ducted propellers. Sponsored by Navy, design includes fore and aft cargo loading facilities on two decks. Wind tunnel work is conducted at Navy's David Taylor Model Basin, Washington, D. C



"Research for Space"

1958's big AVIATION WEEK editorial theme

June 16th marks the publication date of AVIATION WEEK's "Research for Space", 1958's most ambitious and dramatic editorial effort. Major areas of editorial attention: missiles, satellites, spacecraft, space probes, Dyna-Soar, avionics, exotic fuels and hypersonic aircraft, are presently engaging the attention of the world and exciting the imagination of scientific and military minds everywhere. The soaring national defense expenditures earmarked for national defense effort in these fields and general aviation procurement, amounting to some $10 billion scheduled to be expended in the second half of 1958, i. e (January-June 1958) spotlight the timeliness of this issue.

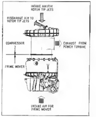
Last year's "Research and Development" issue generated over 18,000 top-quality inquiries. This year's "Research for Space" edition will exceed this number substantially. *Regular AVIATION WEEK* contract rates will apply. Positions will be accorded on the basis of the date insertion orders are received. Now is the time to schedule your advertising message in 1958's most dramatic and useful edition, "Research for Space".

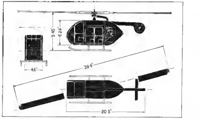
World-wide distribution of over 70,000* net paid subscribers plus several thousand extra copies for copy sales to scientific, military, industry and government personnel, provides industry advertisers with an unmatched audience for the sale of their services, materials and products.

*Net Paid ABC December 1957: 67,008.

Aviation Week
Including Space Technology

A McGRAW-HILL PUBLICATION,
330 WEST 42nd STREET, NEW YORK 36, N. Y.





FIAT 4700 gas generator powerplant (left) for pressure-jet drive Fiat 7002 helicopter is rated at 530 gas horsepower for takeoff and 500 ghp maximum continuous Air delivery rate is about 7.5 lb./sec at takeoff and 7.4 during cruise. Three view drawing of helicopter (right) shows vertical installation of gas generator, simplicity of fuselage design Seven place mockups have been constructed

Fiat Selected Cold-Jets for Simplicity

By David A. Anderton

Turin, Italy—Prototype Fiat 7002 pressure-jet helicopter is expected to fly in about one year, although there is a possibility it may be airborne before the end of 1958

Rotor mast, head and blades have been completed for the first airframe Components of the cold jet system have been fabricated in full size and are entering the dynamic test stage

Mockups of the seven place aircraft and its control system have been built and are now being used to check out the detailed design which is nearing completion

Fiat Aviation Division, which missed the chance to get a license from Bell Helicopter Corp to manufacture its helicopters in Italy, is trying to make up for lost time by designing its own rotary wing craft aimed at needs of the European operator

Prospects for production of such aircraft are good in Italy, the company believes, and the seven place advanced design should be attractive to operators in Europe

After the preliminary design, Fiat marketing experts made a survey of the prospects for such a helicopter and found them good The company's design was accepted by the Italian government and is currently being supported by it to the extent of 50% of the estimated cost Mutual Weapons Development Program accounts for the other 50% and, said a Fiat engineer, "We are putting up the third 50%, because it's going to cost more than the estimates."

Primary aims of the design team under Ing Trinchieri were the usual factors of low initial cost and low maintenance cost

Designers knew this could only be done with a simple design and, after studying a number of possibilities, settled on the pressure jet principle with cold jets as being probably the simplest basic drive system

Since then they have been developing the transmission, studying it as a basic system and testing it in component form. Rotary seals, flexible joints and the blade shape have been devel-

Fiat 7002 Helicopter

PHYSICAL CHARACTERISTICS	
Normal gross weight, lb.	3,080
Empty weight, lb	1,320
Useful load, lb	1,760
Rotor diameter, ft.	39.4
Blade chord, ft	1.41
Fuselage length, ft.	20 5
Fuselage width, ft.	4.6
Fuselage height, ft.	6.24
Overall height to blade chord plane, ft.	9.45
POWERPLANT CHARACTERISTICS	
Max. continuous gas horsepower	500
Takeoff gas horsepower	530
Air delivery to rotor, max continuous, lb /sec.	7.36
Air delivery to rotor, takeoff, lb /sec.	7 5
Compression ratio at max continuous rating	2 8
Compression ratio at takeoff	3 0
PERFORMANCE AT NORMAL GROSS WEIGHT.	
Max. speed, sea level standard day, mph	106
Cruise speed, sea level standard day, mph	84
Service ceiling, forward flight, max load, ft	11,150
Operational range, mi.	187

oped after an extensive test program, and the helicopter design geometry has been checked in the Turin Polytechnic Institute wing tunnel.

A study of the layout shows that the engineers had production in mind when the final design was approved. Basically the Fiat 7002 is a lightweight structural box which houses powerplant and people and is hung under a lifting rotor system. A tiny tail rotor is added to help maneuverability at low forward speeds and during the autorotative state.

Powerplant Data

Powerplant is a Fiat 4700 gas generator unit in which the basic gas turbine engine—based on the earlier Fiat 4002 turbojet—supplies hot air output to drive a power turbine that in turn drives a compressor which supplies the air to the cold jets at the blade tips. The engine is rated at 530 gas horsepower for takeoff and 500 ghp maximum continuous. Air delivery rate is about 7.5 lb/sec. at takeoff and 7.4 during cruise.

There is, of course, no mechanical connection between the gas generator and the compressor or its drive, so that the rotor system gains the characteristics of a free turbine drive.

Normal layout has dual controls, plus two passenger seats and a bench seat that holds three. For ambulance work, the center section can take two litters, two more litters can be hung outside and the attendant takes the copilot's seat.

For freight or other static internal loads, the maximum volume available is 89 cu. ft. Overall fuselage length is 20.5 ft., width is 4.6 ft. and height is 6.24 ft. Height to the top of the rotor mast is 9.45 ft.

Two-Blade Rotor

Main rotor is 39.4 ft. dia. and is made of two separate blades with stainless-steel welded leading edges and spar. The air ducts are in the leading edge and the spar. Blades have been fabricated by the Parsons Corp., Aircraft Div., Mich. Fiat may eventually subcontract blade production to Parsons unless conditions make it desirable or necessary for home-built blades.

Rotor head is tilting type, steel tension strips connect the blades and take the centrifugal loads, but allow each blade to change pitch angle.

For versatility of operation, the fuselage section is divided into three sections. Forward is a fixed arrangement and contains the pilot's seat, a copilot's position or flight attendant's or passenger seat, and the necessary controls and instrumentation for either single or dual-control flight.

The fuselage rear section contains the complete powerplant. The center section is the carrier for useful load and can be arranged with six seats or two

litters or freight space. Different types of equipment can also be installed for spraying or dusting, for rescue work, for aerial seeding or fertilizing or any number of the unusual tasks taken on by a helicopter.

The rotor head is attached to the upper portion of the center fuselage section, near the fuel tanks.

The Fiat 4700 gas generator is an adaptation of a light and small turbojet, the 4002, arranged for a vertical installation.

Air intake is from below, through an intake casting of magnesium-zirconium alloy.

The compressor-turbine rotor combination is mounted at the lower end upstream of the compressor on a ball thrust bearing and at the upper end by a roller bearing. The unit is pneumatically balanced to minimize axial thrust on these bearings.

Reverse-flow combustion chamber is extremely short. Its design characteristics are one of the major lines of the company's endeavors in turbojet development. Later engines have combustion chambers that are almost hemispherical in shape and of even shorter lengths than those of the 4700.

Air bled from the compressor is used to cool turbine and rear bearing.

In the air compressor, the power turbine is a single-stage axial unit with alloy steel disc and high nickel-steel buckets. The compressor is made of magnesium alloy, its diffuser frame and air manifold are a single magnesium-zirconium alloy casting.

Air for the compressor is taken in from above and fed out to the mast through a scroll manifold. Exhaust from the driven-turbine casing is collected in an annular manifold and is turned through 90 deg. to discharge the gas axially along the helicopter centerline. Any residual energy remaining in the gas will then supply thrust for forward motion.

PRIVATE LINES

Tactair pneumatically operated autopilot has been approved for Cessna 310. Nonelectric, nine-pound unit already is approved for Beech Bonanza (A model on), Cessna 180, 182 and Skylane and Piper Apache.

Automatic Scanning Correlator (Auscor) electronically provides photo interpretation data, such as relative heights of image detail, when adapted to a stereo machine. Unit is stated to compute data up to 100 times faster than obtainable using human operators using plotting machines. Auscor was developed by Photographic Survey Corp., Toronto, Canada.

A report to Engineers and Scientists from Lockheed Missile Systems

...WHERE EXPANDING MISSILE PROGRAMS INSURE MORE PROMISING CAREERS

Lockheed Missile Systems is in the forefront of U S missile developers For example, projects like the Polaris strategic ballistic missile are proof of Lockheed's leadership in solid fuel weapons systems

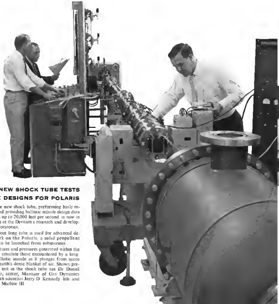
Work on Polaris—and other advanced missile projects we cannot discuss—has led Division scientists and engineers into the most sophisticated areas of research and development. Highly advanced facilities in our multi-million dollar laboratories, near Stanford University, provide the ideal technical environment

As more emphasis is placed on missile's role in U S defense, activities within our missile programs—like those pictured here—will inevitably grow. This means better opportunities for you to move rapidly ahead in your career

Positions are open on all levels in **Aerodynamics, Thermodynamics, Guidance, Propulsion, Flight Controls, Inertial Guidance, Electronics, Ground Support, Information Processing, Structures, Human Engineering, Systems Integration, and Materials Research.** Qualified engineers and scientists are invited to direct inquires to Research and Development Staff, Sunnyvale 17, California

Lockheed **MISSILE SYSTEMS** A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

PALO ALTO · SUNNYVALE · VAN NUYS · SANTA CRUZ · CALIFORNIA
CAPE CANAVERAL, FLORIDA · ALAMOGORDO, NEW MEXICO



NEW SHOCK TUBE TESTS MISSILE DESIGNS FOR POLARIS

This huge new shock tube, performing basic research and providing ballistic missile design data at speeds up to 20,000 feet per second is now in operation at the Division's research and development laboratories

The 44-foot long tube is used for advanced design work on the Polaris, a solid propellant weapon to be launched from submarines

Temperatures and pressures generated within the tube will simulate those encountered by a long range ballistic missile as it plunges from space into the earth's dense blanket of air. Shown preparing a test in the shock tube are Dr Daniel Bershader, center, Manager of Gas Dynamics Dept., with scientists Jerry D Kennedy left and Wayland Marlow III

HOW LOCKHEED HUMAN ENGINEERS HELP MISSILES FLY BETTER

Polaris and other major Lockheed missile systems "fly" better through efforts of Division human engineers like Dr Joseph W Wissel, left, and Dr John E Mangelsdorf, right They are shown with Flight Control Analysis engineer Roy J Niewald, collecting flight control accuracy data on a display parameter

Studies of man machine systems like the missile control station enable engineering psychologists to develop advanced equipment which minimizes the opportunity for human error

Missile flight control is one of the challenging problems which human engineers—working with other Lockheed scientists and engineers—solve in this era of complex missile systems.

PAIR OF UNIVACS SOLVE TOUGH DESIGN PROBLEMS

Two Univac Scientifics today aid preliminary design work for Lockheed missiles by solving tough flight simulation problems at Division laboratories, Palo Alto. These high speed digital computers aid in the study of missile characteristics, performing scientific and engineering calculations and data reduction by means of the most advanced techniques

Above, Dr J P Nash, left, and R V Middleton review instructions at a Univac control console before starting problem.

The \$1½ million computers are part of an installation which is one of the largest and most complete in the West

LMS ENGINEERS DEVELOPING TRANSISTOR FLIGHT CONTROLS

Transistorized flight control systems for the Polaris ballistic missile program are being tested and developed under the direction of Gene Schott, Flight Controls Department Manager, right Schott is shown discussing results of a recent test with design engineer Carlos Avila

Transistorization of missile control systems is receiving top attention from Lockheed Missile Systems engineers and scientists in the interest of saving weight and space over present flight control systems This work is being conducted in the Division's Palo Alto and Sunnyvale laboratories.

WHO'S WHERE

(Continued from p. 23)

Changes

Robert H. Jewett, assistant general manager-chief engineer, Pilotless Aircraft Division, Boeing Airplane Co., Seattle, Wash. Also: **Harvey Gunnoung,** head system test department; **George Snyder,** engineering manager; **John D. Alexander,** advanced projects engineer manager.

H. D. Lowrey, director of operations, Missile Division, Chrysler Corp., Detroit, Mich. Also: **J. F. Lovett,** divisional comptroller, and **B. J. Meldrum,** special assistant to the general manager.

Robert Strich, chief engineer, Cannon Electric Co., Los Angeles, Calif.

Donald P. Frankel, director of customer relations, Chicago Aerial Industries, Inc., Melrose Park, Ill.

Robert J. Helberg, manager-BOMARC weapon system, Pilotless Aircraft Division, Boeing Airplane Co., Seattle, Wash. **Elliott Mock** succeeds Mr. Helberg as BOMARC project engineer. Also: **E. W. Smith,** head preliminary design, Pilotless Aircraft.

Herbert H. Howell, Assistant to the Administrator for Development of Washington International Airport, Civil Aeronautics Administration. **George R. Borsari** succeeds Mr. Howell as Director of the CAA Office of Airports. Also: **Edgar N. Smith,** Planning and Development Officer; **Burleigh Putnam,** Deputy Director of the Office of Flight Operations and Airworthiness; **Dr. John E. Smith,** Chief of the Medical Division of the Office of Flight Operations and Airworthiness.

Tom J. Venator, chief applications engineer, electronic systems and equipment, Nortronics division of Northrop Aircraft, Inc., Hawthorne, Calif. Also: **Dr. Roger S. Estey,** Nortronics technical staff research scientist.

Charles Benton, Jr., general manager, Military Products Division, International Business Machines, New York, N. Y.

Richard W. Couch, project manager-Ballistic Missile Early Warning System, Sylvania Electronic Systems, division of Sylvania Electric Products, Inc., New York, N. Y.

Col. William C. Farmer (USA ret.), weapons systems manager, Solar Aircraft Co., San Diego, Calif.

Ward D. Davis, manager, newly created Special Product Sales Division, Doman Helicopters, Inc., Danbury, Conn. **E. Stuart Gregg, Jr.,** succeeds Mr. Davis as helicopter sales manager. Also: **John W. Mazur,** sales manager-military and commercial engineering services, and **Fred P. Montanari,** sales manager-manufactured products division.

Donald B. Morse, director of sales service and advertising, Scintilla Division, Bendix Aviation Corp., Sidney, N. Y. Also: **Donald L. Quinney,** sales manager; **Leonard D. Williams,** manager-sales office administration; **William L. Bowler, Jr.,** new products manager.

Brendan W. O'Kelly, U. S. Sales Manager, Irish Air Lines.

H. J. H. Wassell, manager of the newly established Test Department, Marconi's Wireless Telegraph Company Ltd., Chelmsford, England. **J. K. Todd** succeeds Mr. Wassell as chief radar engineer.

William N. Snouffer, project manager-Plato anti-missile missile system, Sylvania Electronic Systems, division of Sylvania Electric Products, Inc., Waltham, Mass. **F. J. Anderson,** manager of Sylvania Electronic Systems newly formed Data Processing Laboratory.

Joseph D. Thompson, manager-aircraft instrument engineering, General Electric's Instrument Department, West Lynn, Mass.

J. Warren Gillon, manager customer relations, Electronic Instrumentation Co., division of The Ramo-Wooldridge Corp., Denver, Colo.

F. R. Crowe, assistant manager-commercial, and **A. G. Schramm,** assistant manager-military, Aircraft Parts Department, Allison Division of General Motors Corp., Indianapolis, Ind. Also: **W. O. Higgins,** manager-subcontract sales, Aircraft Engines Operations.

Jack M. Beauchamp, director of field service, Aerojet-General Corp., Azusa, Calif.

W. D. Dilworth, director of traffic administration, United Air Lines, Inc.

H. W. Monroe has succeeded Ray E. Horner as manager-data processing and scheduling, Light Military Electronic Equipment Department, General Electric Co., Utica, N. Y. Through error, it was previously announced that J. A. Cadwallader, who is manager-finance, had succeeded Mr. Horner.

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant	Civil Service Opportunities	Employment Agencies
Positions Wanted	Selling Opportunities Wanted	Employment Services
Part Time Work	Selling Opportunities Offered	Labor Bureaus

—RATES—

DISPLAYED

The advertising rate is $45.00 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising inch is measured 7/8" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

UNDISPLAYED

$2.70 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Position Wanted Ads are ½ of above rate.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of AVIATION WEEK, P. O. Box 12, N. Y. 36, N. Y.

ENGINEERS & SCIENTISTS

INTERESTED IN

FLIGHT PROPULSION LABORATORY of GENERAL ELECTRIC

At the level of investigation in progress at the Flight Propulsion Laboratory, so many technical disciplines merge and overlap, that engineering management here can and will

RE-DESIGN JOB SPECIFICATIONS TO UTILIZE YOUR TECHNICAL BACKGROUND TO THE FULL

—where your experience is substantial

Opportunities now exist for highly qualified people to work with the Laboratory on advanced concepts and engineering principles applicable to jet and rocket propulsion systems that are planned to operate up to Mach 5 and beyond. FPL is interested in you if you have had 3 to 5 years or more in the following areas:

ADVANCED APPLIED MECHANICS ▪ COMBUSTION ▪ MECHANICAL DESIGN & ANALYSIS ▪ NUMERICAL ANALYSIS ▪ DEVELOPMENT TESTS ▪ METALLURGICAL THEORY & PROCESSING ▪ AERO THERMO ANALYSIS

(Also a number of positions for engineers and scientists with 1 to 3 years' experience.)

Write Mr. Mark Peters, Building 100, Department 58-WP, Flight Propulsion Lab.

"Thrust And Progress—showing creative development of FPL—will be sent you on request.

GENERAL ELECTRIC

CINCINNATI 15, OHIO

AERONAUTICAL ENGINEERS

&

MECHANICAL ENGINEERS

Permanent Positions with Sandia Corporation

engaged in ordnance phase of nuclear weapons research and development for the AEC

We have openings for aeronautical or mechanical engineers at all degree levels with 2 to 4 years experience in analysis of systems or structures subjected to shock and/or vibratory loads. Interpretation of environmental data must generally be made to obtain input shock and vibratory loads. Evaluation of structures will often require use of differential equations and a knowledge of static and dynamic properties of various materials. Investigation of structures often involves test proposals to aid in analysis.

Sandia Corporation is located in Albuquerque, N. M. A metropolitan city of over 200,000, Albuquerque is famous for its cultural and recreational attractions, and for its excellent climate—mild winters, cool summer nights, year-round sunshine and low humidity. You'll enjoy generous paid vacations and holidays, and benefit from liberal retirement, hospital and insurance plans. Paid relocation allowance. Send resume to Staff Employment Section 592.

SANDIA CORPORATION

ALBUQUERQUE, NEW MEXICO

VISUAL TRAINING

OF COMMERCIAL AIR LINE PILOTS

To Meet Eyesight Requirements of Periodic Company and C.A.A. Exams

DR. JOHN T. FLYNN

OPTOMETRIST · ORTHOPTIST

Visual Training Specialist

300 W. 23rd St., New York City

By Appointment Only WA 9-5919

ADDRESS BOX NO. REPLIES TO: Box No.
Classified Adv. Div. of this publication.
Send to office nearest you.
NEW YORK 36: P. O. Box 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITIONS VACANT

Operations Manager-Stirkon for Vice President—[illegible] established helicopter operation. Applicant must be capable of supervising domestic and Latin American operations. Both commercial and military aviation background preferred. Must be versed in business efficiency and operational personnel management. Challenging position for a high caliber man. Salary commensurate with ability. Send complete resume first letter. All inquiries confidential. P-7840, Aviation Week.

Helicopter Maintenance Superintendent—Commercial and military maintenance work. Applicant must be capable of turning out production on schedule and maintaining an efficient work program. Experience on Bell helicopters plus military maintenance procedures essential. Excellent opportunity for right man. Salary commensurate with ability. P-7857, Aviation Week.

EMPLOYMENT SERVICE

Technical Ground Service Personnel Available—Free information on Technicians with background in A&E-Electrical—Sheet Metal—Hydraulics Light Aircraft—Helicopters—Jet Powerplants—Airline Maintenance—Contact Pittsburgh Institute of Aeronautics, Allegheny County Airport, P. O. Box 10897, Pittsburgh 36, Pennsylvania. Phone [illegible]—Homestead 1-1500 ext. [illegible]

POSITIONS WANTED

Ex AF Test Pilot Graduate USAF Exp. Test Pilot School (Gen. 2 yrs Flight Test experience) of W-PAFB. Leaving AF due to jet crash injuries which preclude further flying. 1000 hrs, 1000 jet thru century series. Science. Considerable instrument experience including NRA Jet Symposium 1957. Eager to continue in aviation in sales public relations, Flt Test Eng. or related fields. PW-7784, Aviation Week.

Airline Transport Pilot College Background—[illegible] 3000 hours total. DC-3 DC-4 Twin-Beech and Cessna 310. Over one Million Mile Accident Free Flying. PW-7841, Aviation Week.

Ex airline pilot age 38. ATR 7300 hours background [illegible] public relations with two years [illegible] flying South America in all types of aircraft to Europe, the Middle and Far East desires corporation flying position with public relations or sales work connected. PW-7711, Aviation Week.

Experienced Sales Engineer available with established contacts in the East Coast Aircraft Industry will represent your company. [illegible] College Graduate. PW-7740, Aviation Week.

FOR SALE

For Sale—2 Packard Rolls Royce Airplane Engines Model V-1650-1. Ludlow Sales, 1788 S. High St., Columbus, Ohio.

For Sale A-26 Remanufactured April 1953 1800 hrs total time Airframe, 360 hrs SMOH R. E. [illegible] 360 SMOH L. E. Two lounges & white exterior brown & tan interior. A-12 auto pilot complete. Dual Collins omnis & ILS, units 360 channel Collins communications. Collins glide slope. Bendix MKR. Isolation Amplifiers 6 speakers. 10 channel MHD transceiver. Spare engine completely built up for quick change, many other spares. Price complete $168,000.00. FS-7569, Aviation Week.

ENGINEERS • SCIENTISTS

Electron micrograph of titanium alloy sample magnified 10,000 times showing particles which inhibit plastic flow of matrix material, imparting strength for which metal is known.

AT EVERY STAGE FROM BASIC RESEARCH TO HARDWARE **REPUBLIC ENGINEERS & SCIENTISTS** REALIZE PROFESSIONAL SATISFACTION TACKLING SUPERSONIC & UPPER ATMOSPHERE PROBLEMS FOR AIRCRAFT & MISSILES

The multiplicity of programs in progress at Republic affords engineers and scientists the opportunity to express their individual talents in solving today's and tomorrow's problems for manned and unmanned supersonic and upper atmosphere aircraft and missiles. For over 25 years, Republic Aviation has been a vital leader in flight with a record of many significant firsts in advancing the state of the art.

▲ *The photomicrograph shown above is just one example of the thoroughness with which our research and development people explore vital new projects. Important positions are open immediately.*

SPECIALISTS — Engineers
5-7 years experience — BS, MS

Aeroelasticity — AE. To evaluate interactions of structural deformation and aerodynamic loading and their effects on structural design and stability and control of airplane or missile. Preliminary investigations on flutter requirements.

Propulsion Systems — Requires strong theoretical background in order to evaluate new propulsion systems for specific applications. Also responsible for general power plant and ejector performance analyses, formulation of engine control requirements.

Heat Transfer — AE or ME. Heavy experience in heat transfer thermodynamics. To work in area of aerodynamic heating of aircraft or missiles and re-entry problems of space vehicles.

Air-Conditioning & Auxiliary Equipment — To establish heat load requirements for air-conditioning systems from study of functional usage and specific environment of flight vehicles. Supply technical data for the design of the selected system and its internal ducting.

Engine Air Inlet & Exhaust — AE, ME. Experience in analysis of internal and external aerodynamics at supersonic speeds. Responsible for coordinating inlet design with airframe and engine configuration.

SPECIALISTS — Engineers — Physicists — Mathematicians
7-10 years experience — BS, MS or PhD

Operational Analysis — Reconnaissance & detection systems. MS with broad background missile or aircraft field (electronics, vehicle performance, armaments, structures or applied mathematics).

Operational Analysis — Reconnaissance & detection systems. MS. Requires extensive knowledge of probability & game theory.

Operational Analysis — Armament systems (Advanced bombers). BS with 4-5 years relative experience. Understand current armament principles and damage criteria.

Guidance Systems — EE or Physics background in design and analysis of inertial navigation systems.

Reconnaissance Systems — MS Physics. Application of optics and infra-red techniques.

Theoretical Fluid Dynamics — AE or Physics MS or PhD. To conduct basic research in fluid dynamics related to hypervelocities of flight in rarefied atmosphere at orbital speeds. Requires strong aeronautics understanding kinetic theory of gases applied to field Reynolds number and dissociation effects.

Aerodynamics Development — AE. To perform parametric studies in preliminary design stage of aircraft, missile or space ship projects. Needs imaginative cast of mind plus solid background in propulsion, aerodynamics, stability and control, trajectory and wind tunnel testing.

Air Load Design Requirements — AE. To visualize and select critical design conditions essential to estimating air pressure distribution on various components of aircraft or missiles.

Send complete resume, in confidence, to:
MR. GEORGE R. HICKMAN
Engineering Employment Manager

REPUBLIC AVIATION

Farmingdale, Long Island, New York

ENGINEERS...

Let's Trade Ideas!

SPERRY PHOENIX

wants your ideas on advanced flight control systems . . .

and here's an idea

YOUR FAMILY will like!

IF data sensors, gyroscopics and/or advanced electronics are your specialty, your ideas are needed by this new, important division of Sperry Rand Corporation

And we know you and your family will like the idea of wholesome, sun filled, fun filled life in Phoenix! You'll like the year around picnic weather . . . clean dry air . . . spectacular scenery . . . remarkably low housing costs . . . the wide pleasant, uncrowded streets that carry you to work You'll like Arizona's well rated grade and high schools . . . and the fact that nearby colleges offer you advanced courses

You and your family will like the idea of living in friendly, easygoing Phoenix!

We're building a basic staff at Sperry Phoenix Company to spearhead research development and applications Starting salaries and opportunities for increases are right at the top There's a great future for top notch idea men . . . and their families . . . in Phoenix

Here's another good idea mail the coupon today!

If you believe you are qualified for advanced flight control systems and associated aircraft equipment engineering return this coupon without delay (no need to send resume) while these rare basic staff positions are still open By return mail you will receive an application Mail the coupon now . . . this is an unusual opportunity for you and your family!

SPERRY PHOENIX COMPANY

DIVISION OF SPERRY RAND CORPORATION

PHOENIX, ARIZONA

'Win' Ames
Sperry Phoenix Company • P O Box 2529 Phoenix, Ariz.
I'm interested! Please send me a confidential application

NAME__________

ADDRESS__________

CITY______ ZONE______ STATE______

W 48

Our Aircraft Division Has Openings on VTOL Development Programs For

SENIOR STATIC AEROELASTICIANS

Experienced in the latest analytical, model test, and flight test methods of predicting and substantiating divergence, control effectiveness, and effects of aeroelasticity on aerodynamic loads and stability derivatives for high performance aircraft

SENIOR FLUTTER AND VIBRATION ENGINEERS

Experienced in the latest analytical, model test, prototype vibration and flight test methods of predicting and substantiating vibration characteristics and flutter boundaries for high performance aircraft

If interested, send resume to

Supervisor of Engineering Employment
Dept. E 26

BELL AIRCRAFT CORPORATION
P O Box 1 Buffalo 5, New York

ENGINEERS

AERODYNAMICS and AIRCRAFT DESIGN

Unusual opportunity for three capable engineers

AERODYNAMICIST—Experienced in stability and control analysis of aircraft with ability to handle design and development of VTOL configurations

AERODYNAMICIST—Experienced in performance analysis and load distribution with ability to apply this experience in VTOL aircraft design and development

AIRCRAFT DESIGNER—Experienced in small aircraft design to act as group leader on experimental VTOL aircraft Location—Northern New Jersey.
Send detailed resume to

P 7756 Aviation Week
Class. Adv Div P O Box 12 N Y 36 N Y

THIS EMPLOYMENT OPPORTUNITIES SECTION offers a quick effective solution to your manpower problems Because its readership is confined to just the type of men you need, waste circulation is avoided

ENGINEERS

General Electric Announces Opportunities in Area of

BALLISTIC MISSILE DEFENSE ENVIRONMENTS

Wide Diversity of Positions Include D & D on Long-Range Surveillance Radar

These openings are with the Missile Detection Systems Section of G. E., designer and producer of what are believed to be the most powerful long range radar detection systems in the world

Current programs involve work on still more advanced systems —among them Ballistic Missile Early Warning Surveillance and other super radar systems to detect ICBMs as they rise over the horizon at distances up to several thousands of miles.

No technical area makes greater demands on the scientific skills and creative imagination of the engineer than Ballistic Missile Defense Environments

<u>Openings for engineers with 4-10, or more, years' experience in:</u>

SYSTEMS DEVELOPMENT

Radar Systems Development

Systems Analysis

Data Analysis

Electronic Countermeasures Systems

Computer Programmers

<u>Openings for engineers with degree and 2 or more years' experience in:</u>

Antenna Design & Development

Antenna & RF Components Development

UHF A M/Wave Receiver Development

Video Display Development

Data Reduction Equipment Design & Development

Transistor Applications

Structural Design

Computer Applications

Qualified engineers will be invited to visit the Missile Detection Systems Section and judge at first hand the unusual opportunities offered for professional growth—and the excellent living conditions in-and around Syracuse, New York. Please write in confidence to: Mr. James P Kinsella, Div 58WP

MISSILE DETECTION SYSTEMS SECTION
HEAVY MILITARY ELECTRONIC EQUIPMENT DEPT

GENERAL ELECTRIC

Court Street, Syracuse, New York

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATE

The advertising rate is $31.00 per inch for all advertising appearing on other than a contract basis. Contract rates on request.
AN ADVERTISING INCH is measured 7/8 inch vertically on one column, 3 columns—30 inches—to a page.
EQUIPMENT WANTED or FOR SALE ADVERTISEMENTS acceptable only in Displayed Style.

UNDISPLAYED RATE

$2.70 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

PROPOSALS $1.60 a line an insertion.

BOX NUMBERS count as one line additional in undisplayed ads.

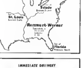
Send NEW Ads or Inquiries to Classified Adv. Div. of Aviation Week, P. O. Box 12, N. Y. 36, N. Y.

FOR SALE
C-46F AIRCRAFT

Passenger and Cargo
With or Without
T-Category Kit Installed

Immediate Delivery

THE FLYING TIGER LINE INC
Burbank, Calif.
Call or Cable
FRED BENNINGER
Executive Vice President
Tel Stanley 7-2411 Cable: Flytiger



IMMEDIATE DELIVERY

TWO C46Rs 49,900 lbs
T CATEGORY

TAS 220 mph 21 000 lbs useful
Zero time Cargo interior
Licensed for up to 62 seats
We are the owners

L AND J TRADING COMPANY
P. O. Box 1865 Int'l Airport
Miami Phone MO 5-3771
ASK FOR P. E. DIXON OR E. E. JONES

AN FITTINGS & HARDWARE
Stainless Aluminum, Brass, Steel
All sizes—immediate delivery from world's largest shelf stock. Buy direct from manufacturer. Lower prices—quicker service. Send for free wall charts showing complete line of AN & MS fittings and hardware. We also machine parts to your own special print and stock AN & MS forgings.
COLLINS ENGINEERING CORPORATION
9067 Washington Blvd. Culver City, California

Deal Directly with Owner

FOR SALE, TRADE, LEASE
DOUGLAS DC-3

[illegible] ... Available for immediate delivery. Liberal finance terms available & [illegible] to purchase or lease, reflecting low payments to put them to work. For complete details, telephone.

TRADE-AYER COMPANY
Linden Airport Linden N J
A J Mleg Wabash 5-3000

FOR SALE
DC-4's
B & E Models
Fully Convertible
Overseas & Domestic
Financing Available

United States Overseas Airlines Inc
Chrysler Bldg New York N Y
Telephone VUkon 6-6685
Cable USOALINES NEWYORK
TWX NY 1-3486

Immediate Delivery

We stock, overhaul and install

PRATT & WHITNEY	WRIGHT
R1830	R1R2D
-75 -92 -94	-202 -8 -72

R9R5 R1340 R2000

and our most popular DC3 engine
R1830 - SUPER - 92

ENGINE WORKS
INC
Lambert Field Inc St Louis Mo

WHY PAY MORE?
FOR SALE
C-46, DC-3, and C-47 AIRCRAFT
Passenger & Cargo
Immediate Delivery

ZANTOP AIR TRANSPORT, INC.
Detroit Metropolitan Wayne County Airport
Tel (Detroit) WHitney 1-2100 Inkster, Mich.

THE
SKYMOTIVE
STORY
Complete
INSTRUMENT
SALES and SERVICE
Skymotive
O'HARE FIELD CHICAGO

Deal Directly With Owner

S-51 SIKORSKY HELICOPTERS

CAA commercial[?] licensed [illegible] Sikorsky S-51 helicopters. For the first time we ever can offer a substantial quantity of helicopters individually or as a lot backed with spare parts for an extensive helicopter operation. Excellent performance and attractively priced in an overhauled or as is condition will be delivered. For a fleet operator a complete package with quantity discount. Details provided.

A J Mleg Wabash 5-3000
TRADE-AYER COMPANY
Linden Airport, Linden N J

INVERTERS
POWER SUPPLIES
PARTS
CLARENCE CARRUTHERS, INC
188 First Street Mineola L I New York
Pioneer 2-0871
Cable Clercarru Mineola New York

FOR RATES OR INFORMATION
About Classified Advertising

Contact
The McGraw-Hill Office
Nearest You

ATLANTA 3—1301 Rhodes-Haverty Bldg. JAckson 3-6951
R POWELL
BOSTON 16—350 Park Square HUbbard 2-7160
J WARTH
CHICAGO 11—520 No Michigan Ave MOhawk 4-5800
W HIGGENS
CINCINNATI, 37—2005 Seymour Ave ELmhurst 1-4150
F ROBERTS
CLEVELAND 13—1164 Illuminating Bldg SUperior 1-7000
W SULLIVAN
DALLAS 2—1712 Commerce St Vaughn Bldg Riverside 7-5117
G JONES
DETROIT 26—856 Penobscot Bldg WOodward 2-1793
J GRANT
LOS ANGELES 17—1125 W 6 St MAdison 6-9351
R YOCOM
NEW YORK 36—500 Fifth Ave OXford 5-5959
R OBENOUR — D COSTER — R LAWLESS
PHILADELPHIA 3—Six Penn Center Plaza LOcust 8-4330
H BOZARTH — R EDSALL
ST LOUIS 8—3615 Olive St JEfferson 5-4867
F HOLLAND
SAN FRANCISCO 4—68 Post St DOuglas 2-4600
W WOOLSTON

ADVERTISERS IN THIS ISSUE
AVIATION WEEK, APRIL 21, 1958

CLASSIFIED ADVERTISING
F J Eberle Business Mgr

ADVERTISERS INDEX

LETTERS

Excellent Coverage

I am writing you in order to express my appreciation for the excellent article in the Jan 27 issue of AVIATION WEEK (p 70) concerning our shipboard operations. I feel that the article and accompanying photographs expressed our mission and experiences especially well.

Once again thank you for the excellent coverage. Your publication is very well regarded by us all.

C C BURKER
Commanding Officer
Fighter Squadron Thirty Two
United States Atlantic Fleet
Naval Air Force

Negative Destruction

Mr Willis L Nye in his letter published on Feb 3 (p 118) reflects the bitter sentiments of hundreds of us who attempt to preserve a bit of our valuable history. Although he has accurately described most of the facts surrounding the burning of 44,000 original negatives of 8 x 10 in size, I wish to add some additional information.

Mr Florian DeDonato and I, with the blessings of Mr J J Sloan, filed a complaint with the Hon Joe Holt, Representative in Congress from the 22d District, Calif. His query to Maj Gen Joe W Kelly, USAF Director of Legislative Liaison, recently brought forth a file of material which completely illustrates the manner in which the destruction of our national heritage can occur without the slightest chance for a public challenge. This entire project began with AGCZ Form 60 in May 1955. This Records Analysis Sheet, signed by Mr Allen Cannon of the Wright Patterson Records Management Office, recommended destruction because "Negatives present fire hazard and are deteriorating with age." The second reason marked in the form was to "reduce cost of space or equipment." These harmless negatives were also said to be a menace to human life and health.

These good people contend that they have preserved the material by making 35mm microfile negatives from file prints and that the prints made from microfilms are "adequate for the U S Air Force needs." I can assure you that no self respecting photographer would ever agree that a microfilm record, shot on 100 ft strips of film, could produce enlarged prints that could even approach the quality of those made from 8 x 10 original negatives. Also no mention is made about producing prints of adequate quality for the taxpaying public, the same public that must pay out 55¢ to $1.50 per print to obtain these photographs. Although the Air Force admits that over 1,000 references per month were received in 1954 in connection with these photographs, they could see little reason for preserving the negatives. Why? Because they claimed that "the nitrate film can no longer be used" to make reproductions. This is pure hogwash. As late as the summer of 1956 Mr J J Sloan and I were borrowing these negatives

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will print anonymous letters, but names of writers will be withheld on request.

from Wright-Patterson AFB and making beautiful prints on No 0 and No 1 Velox or Azo paper.

Although this could proceed ad infinitum, I will stop here with the astute observation that these civil servants will undoubtedly suggest that we make a microfilm of the Constitution and then destroy that paper as a hazard. I would like to point out that many of us as a group had offered to preserve the negatives at our own expense. Of course, there is always an archaic law that can be found to prevent this. What say you, Mr Nye? Shall we encapsulate the heretics?

WARREN M BODIE, Chairman
Aero Historical Society
Woodland Hills, Calif

Scientific Policy

On reading President Eisenhower's statement on space (AW Feb 10, p 37) I felt he must be just as confused as everyone else about our long-term space objectives. Mr McElroy's appointment of Roy W Johnson as ARPA head (AW Feb 17, p 28) indicates that we have arrived rather at chaos than confusion.

It is not specifically Mr Johnson to whom I object; rather it is the underlying philosophy of the Administration's general scientific policy since Sputnik. Apparently creation of a new agency is the sole solution the Administration can find for a difficult technical problem.

Most of us in the research and development industry have watched new agencies come and go and we know by now that new agencies will in all probability be staffed by misfits from already-existing agencies—the same people who have failed miserably in their present jobs to cope with the same problems the new agency has been created to solve.

The Congress is at fault either for not recognizing or for ignoring for political reasons the basic facts of research and development life: worthwhile progress is made only through steady support of sound research and development programs; progress is not made by creating a new agency which must then first determine areas in which worthwhile contributions could be made, then implement a program.

The Administration is at fault because it consistently chooses for technical jobs people having less than the requisite technical background and experience.

Given the present situation there must be many citizens who wish they had lived 20 years ago, or that their children had been born Russian.

HENRY C ALBERTS
Lynnfield Center, Mass.

NACA Runs Range

As a long-time reader of your fine publication, permit me to compliment you on an unusually high standard of accuracy in reporting a very difficult and highly technical field. However, I must draw your attention to the fact that in your article on "Navy Details Needs for Space Mission" in the March 24 issue of AVIATION WEEK (p 37) you made reference to the fact that the X-15 high-altitude research vehicle would be monitored on initial flights by the Navy's inland tracking range which extends from Pt Mugu to Dugway Proving Ground in Utah.

As the original Air Force Project Engineer on the X-15 Radar Range I must take exception to this statement. In addition, I am sure that the large number of Air Force, NACA and Electronic Engineering Co contractor personnel who have labored hard and long this past year and one half to make the X-15 Radar Range a reality must take exception also. In fact, I believe the details of this radar tracking range were reported in an earlier issue of your magazine.

As pointed out in your recent article, the X-15 will be launched from the far end of the range and pass down range to land on the dry lake bed at Edwards AFB. The X-15 Radar Range, as recently planned, will be operated by NACA personnel and will follow the flight of the X-15 and provide for all the usual range functions.

Keep up the good reporting.

JEROME J DOVER
Southwest District Manager
Ampex Corp
Los Angeles, Calif

Rail Bending

With reference to the bottom photo on p 51 of the Feb 10 issue of AVIATION WEEK, may I suggest that the reason for the bending of the rail is not unknown. Such a bending is due to residual stresses due to creep.

When the sled runs, the head of the rail gets hot and therefore it undergoes compression, the thermal expansion being prevented. The axial compressive stress is relieved by creep, which causes an irreversible negative strain component. In other words, the rail's head becomes such as if it was shorter at ambient temperature but expanded thermally up to its actual length.

When the rail cools off, therefore, the reverse stress distribution takes place with the rail's head under axial tension. This cannot be relieved by creep because the material cannot creep at low temperatures. We have, therefore, a residual stress distribution of the bending type. Actual bending is prevented by the tiedowns and it actually takes place when these are broken.

The photo is very interesting and it helps to understand the importance of creep in the stress distribution.

DR CARLO RIPARBELLI
San Diego, Calif

GOOD BUSINESS: Flying Cessna

GOOD FLYING: Planes that use Reynolds Aluminum

More and more businessmen are finding real economy in doing their own flying in sturdy, smooth-flying planes like Cessna's.

Of course, the big reason for the growing popularity of Cessna business planes is their dependability, their ruggedness, their smooth, easy-to-handle performance. Cessna engineers design them that way.

But, it's one thing to design performance into a plane, and another to *build* it. Cessna makes sure by using Reynolds Aluminum in virtually every part of its airplanes—from wing spars to structural members—highest quality sheet, plate and extrusions.

Reynolds has integrated production facilities that are unmatched in the aluminum industry. Cessna uses these facilities to advantage—just as every major aircraft manufacturer does. They know they can depend on Reynolds for the highest quality aluminum in any form or alloy they specify, for technical assistance, and for dependable delivery.

For details on these services write *Reynolds Metals Company, P.O. Box 1800-TJ, Louisville 1, Kentucky.*

The Finest Products Made with Aluminum

are made with

REYNOLDS ALUMINUM

For below-mill quantities of AND sections and other aircraft shapes, contact our specialty aircraft extrusion distributor, Pioneer Aluminum, Inc., 5251 W. Imperial Hwy., Los Angeles 45, Calif. Telephone: ORegon 8-7621.

Watch Reynolds All-Family Television Program, "DISNEYLAND", ABC-TV.